Public Document No. 34

FOURTH ANNUAL REPORT

OF THE

STATE DEPARTMENT OF HEALTH

OF

MASSACHUSETTS

BOSTON
WRIGHT & POTTER PRINTING CO., STATE PRINTERS
32 DERNE STREET
1919

Publication of this Document
approved by the
Supervisor of Administration.

CONTENTS.

SUPPLEMENT.

FOURTH ANNUAL REPORT

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STATE DEPARTMENT OF HEALTH

OF

MASSACHUSETTS.

For the fiscal year ending Nov. 30, 1918, the State Department of Health was constituted as follows: —

Commissioner of Health (until April), . . Allan J. McLaughlin, M.D.
Commissioner of Health (appointed April 1), . Eugene R. Kelley, M.D.

Public Health Council.

Eugene R. Kelley, M.D., *Chairman.*

David L. Edsall, M.D., 1921.
J. E. Lamoureux, M.D., 1921.
Wm. J. Gallivan, M.D., 1919.
John T. Wheelwright, 1919.
George C. Whipple, S.B., 1920.
Wm. T. Sedgwick, Ph.D., 1920.

During the year fifteen formal meetings of the Council were held, and in addition numerous meetings of the standing and special committees of the Department. The standing committees are as follows: —

Sanitary Engineering (including Housing and Rural Hygiene).

Professors Whipple and Sedgwick, Dr. Kelley and Mr. Wheelwright.

Preventive Medicine and Hygiene.

Drs. Edsall, Gallivan, Kelley and Lamoureux.

Food and Drugs.

Professor Sedgwick, Drs. Gallivan and Lamoureux.

Finance, Law and Demography.

Dr. Kelley, Professor Whipple, Dr. Gallivan and Mr. Wheelwright.

On April 1, 1918, the Department suffered a heavy loss in the resignation of the Commissioner of Health, Dr. Allan J. McLaughlin.

By an act of the Legislature of 1914 the State Board of Health, which had existed since 1886, was replaced by a Department of Health composed of a Commissioner of Health and a Public Health Council, and in the autumn of that year Dr. McLaughlin was appointed to the commissionership. To this new and important post Dr. McLaughlin brought a high reputation as an officer of the United States Public Health Service, with unusual experience in public health activities, both scientific and administrative, in the United States, in Europe and in the Philippine Islands. For three years and a half he devoted himself unsparingly to the service of the State of Massachusetts, bringing the new Department of Health to a high level of usefulness and success, and demonstrating by his professional knowledge, his ability, his energy and his personality, administrative qualities which won for him the regard and respect of his associates and subordinates.

The vacancy left by the resignation of Dr. McLaughlin was immediately filled by the appointment of Dr. Eugene R. Kelley, Director of the Division of Communicable Diseases of the Department, and formerly Health Commissioner of the State of Washington.

Rufus Mason Whittet, C.E., principal assistant engineer of this Department, died on Dec. 10, 1918, a victim of the prevailing influenza epidemic. Mr. Whittet joined the engineering staff of the State Board of Health upon his graduation from the Massachusetts Institute of Technology in 1902, and had been the principal assistant engineer of the Department since 1908. His energy, thoroughness, clear thinking and sound judgment were of invaluable assistance in the studies of water supply and drainage, and the great variety of kindred problems embraced in the work of the Department, while his quiet manner, his fairness and his kindness made work with him a pleasure. These qualities, with a high sense of honor and loyalty to his associates, made him respected by all and loved by a wide circle of friends.

In accordance with section 2, chapter 792 of the Acts of 1914, at a meeting of the Public Health Council on Dec. 24, 1918, the Commissioner of Health submitted to the Council a report of the activities of the Department for the fiscal year 1917, together with recommendations for legislation, and it was voted that this report be approved and adopted as the report of the State Department of Health for the fiscal year 1918.

REPORT OF THE COMMISSIONER OF HEALTH.

To the Public Health Council.

GENTLEMEN: — In the fiscal year 1918 events have occurred and circumstances arisen of such unusual character as to render the year noteworthy in the health annals of the Commonwealth. In the list of unusual occurrences the great influenza epidemic with its unprecedented mortality holds first place. This disaster is still too recent to permit exact statements, and its remote effects upon the public health cannot as yet be predicted. It has largely overshadowed certain other important health developments of the year that deserve emphasis, as the effect of war conditions upon the work and personnel of the Department, especially the Department's venereal disease campaign, and the progress of the child conservation measures inaugurated during the previous year. Before summarizing the routine and emergency activities of the several divisions of the Department, I desire to comment upon each of these subjects.

THE INFLUENZA EPIDEMIC.

Massachusetts is just emerging from the most disastrous epidemic that the Commonwealth has ever known. While the statistical data of sickness and death caused by it are not as yet available so that exact comparisons can be made, the incomplete records indicate that the initial point of invasion into the country was among naval units stationed within the State; that the virulence of the disease was relatively high within our borders; that Boston and certain of the larger cities of the Commonwealth were stricken with unusual severity; and that possibly the State as a whole suffered greater proportional infection and fatality than any other in the Union.

Deaths from the resultant pneumonia are still occurring daily in many parts of the State, and it is too early to obtain complete returns for the month of November. From returns available it is very evident that the total mortality, exclusive of deaths among military forces within the State, directly attributable to the epidemic is probably not less than 15,000 from its inception in the second week of September to the 1st of December.

The total number of cases cannot be determined with any such degree of accuracy as can the deaths. Conservatively estimated, at least 400,000 persons were affected over the same period to the extent of being unable to pursue their ordinary occupations for several days. Moreover, strictly speaking, the epidemic cannot be said to be over, as many cases are still being reported from various localities.

Influenza had never been one of the reportable diseases in Massachusetts. At the beginning of the epidemic the local boards of health were requested by the State Department of Health to report all cases and deaths due to influenza. Later, by vote of the Public Health Council on September 30, influenza was added to the list of reportable diseases. By this means prompt warning of new foci of infection was given, and more accurate knowledge of the increase or decrease of the number of cases in a given community was furnished. Acting upon this information the Department was better enabled to furnish medical and nursing assistance to the localities most in need, and to send pamphlets giving instructions relative to the care of the sick to the homes from which cases of the disease were reported.

The task of combating influenza was greatly hampered by the inadequate supply of physicians and nurses, due in great part to military enlistment. A medical and nursing enrollment bureau was established at the State House by the Department, and calls were sent throughout the New England States, New York and Pennsylvania for physicians, graduate nurses and nursing assistants. An appeal was sent to the Federal government for physicians and nurses. Advertisements were placed in the newspapers calling for aid, and local boards of health were requested to send in a statement of their existing nursing and medical resources and hospital accommodations, as well as their need for further assistance. On September 30 Passed Assistant Surgeon W. S. Draper, detailed from the United States Public Health Service, with seven commissioned officers as assistants, reported for duty. Dr. Draper's office was established in the State House, and his assistants were detailed to the larger cities. The assistance furnished by the Federal government in this manner was exceedingly valuable, and was deeply appreciated throughout the State.

An epidemic emergency committee headed by Mr. Henry B. Endicott, executive manager of the State Public Safety Committee, was appointed by the Governor, and co-operated with the Department most vigorously throughout the epidemic. Under the leadership of this committee volunteer organizations sprang up throughout the cities and towns of the State, which busily engaged in questions of supplies, relief, emergency hospital equipment, enrolling of volunteer assistance, and numerous other activities designed to assist the city and town boards of health, hospitals and other official groups dealing with the epidemic. The existing hospital facilities of the State were entirely inadequate to accommodate the vast number of cases requiring hospital care, and about 50 emergency hospitals, varying in size from 5 to 500 bed capacity, were established.

In those communities where the hospital situation was most serious,

upon request of the local civic authorities and recommendation of this Department, the State Adjutant-General, Quartermaster-General, and Surgeon-General established tent and shack military hospitals. Very excellent results were obtained in these hospitals, all of which were conducted upon the open-air principle. In all, 9 such military hospitals were established, with a total of 2,020 patients admitted and an average fatality per cent of 14. They were located in the following communities: Brookline, Gloucester, Brockton, Ipswich, Lawrence, Waltham, Haverhill, Barre and Springfield. Special recognition should be made of the self-sacrificing spirit in which so many co-operated throughout the State to make these institutions a success.

The Governor was requested to communicate with army and navy authorities, and to recommend that all leaves of absence for soldiers, sailors and other personnel under their control be discontinued during the course of the epidemic.

Dr. Timothy Leary, professor of pathology at Tufts Medical College, produced an influenza vaccine which it was hoped might prove an effective prophylactic and therapeutic agent. The following special boards were appointed for the scientific and statistical investigation of the efficacy of this vaccine: special board for statistical investigation, George C. Whipple, chairman, William H. Davis and F. S. Crum; special board for scientific investigation, M. J. Rosenau, M.D., chairman, Dr. Frederick P. Gay and Dr. George W. McCoy. It was felt that there should be no delay in providing the public with an agent having promise of good. Accordingly, Dr. Leary was authorized to proceed with the manufacture of this vaccine in quantity at the expense of the Commonwealth before the reports of the boards were received, in order that a favorable report might find the Department with a supply on hand for immediate distribution. This was done at a total expenditure on the part of the Commonwealth of over $19,000. The report of the special reference board was not entirely favorable, and reports from physicians making use of the vaccine were contradictory. A considerable supply was, however, distributed, meeting all calls for it, because it was felt that any measures sponsored by a pathologist of Dr. Leary's professional reputation should be given the fullest trial. Detailed reports as to its preventive effects were requested from the persons to whom vaccine was administered, as well as from physicians and institutions. Although in some instances striking protective results were reported, these were offset by other instances where no protection was observed. Carefully checked results were followed in the case of a large State institution, where a total of 403 persons from both the administrative staff and the institutional inmates, well distributed in various parts of the institution, representing 40 per cent of the total population, were vaccinated and the

remainder not vaccinated. The disease had not occurred in the institution prior to the vaccination, but did appear soon thereafter, the first case occurring four days after the completion of vaccination. Of those vaccinated, 40 per cent were taken sick, and of those taken sick in this group 17 per cent died. Of those unvaccinated 31 per cent were taken sick, and of these 13.5 per cent died. From this and similar occurrences the staff of the Department regretfully but unanimously was forced to the conclusion that upon the evidence available the vaccine had no marked prophylactic value.

In all, during the course of the epidemic, 1,003 nurses and nurses' aids registered and were sent out by the enrollment bureau for service in different parts of the State. Of these nurses and nurses' aids 79 contracted the disease while in the State's employ, and 7 of the cases were fatal. Of the 15 nurses sent by the Commonwealth of Pennsylvania to aid Massachusetts in the early stages of the epidemic, 2 died of the disease after their return home. Two hundred and fifty physicians and fourth-year medical students were sent out by the enrollment bureau, and of these, 113 accepted commissions in the Federal Public Health Service. Many of these physicians, nurses and assistants came from a distance to aid Massachusetts, and all gave unstintingly of their strength and time in helping to check the inroads of the epidemic. To each and all of them the Commonwealth is deeply grateful.

In addition to the expenditures by the Adjutant-General's office and the State Public Safety Committee, the total financial liability assumed by the Commonwealth through this Department, with the approval of the emergency health committee, in combating the influenza epidemic amounts approximately to $100,000. The principal items of expense are for salaries and expenses of physicians, nurses and nurses' aids, — approximately $75,000, — and for the expenses incidental to the manufacture and testing of influenza vaccine, — approximately $19,000.

The Influence of the War upon State Health Activities.

The direct and remote effects of the war upon the activities and personnel of the Department during the past year have been far-reaching.

The most prominent change was the recalling of the Commissioner. Dr. Allan J. McLaughlin, on April 1, 1918, to active duty as Assistant Surgeon-General of the United States Public Health Service.

In addition to losing the aggressive leadership of Dr. McLaughlin as a result of the war, the Department has sustained throughout the year constant losses in its personnel, until in all 33 out of a total force of approximately 125 have entered active military service.

Service Roll of Department.

A. J. McLaughlin, M.D.,	U. S. Public Health Service.
Mary Dopkeen,	U. S. Naval Service.
Joseph P. Baggs,	7th Field Artillery, U. S. A.
Forrest E. Harbour,	115th Regiment, Engineers, U. S. A., A. E. F.
Francis F. Kingsbury,	306th Regiment, Engineers, U. S. A., A. E. F.
Arthur D. Weston,	Engineers' Reserve Corps, U. S. A., A. E. F.
Alexander Bresth,	Sanitary Corps, U. S. A.
E. R. Hatton,	U. S. Naval Service.
John J. County, Jr.,	101st Regiment, Engineers, U. S. A., A. E. F.
William L. Campion,	Red Cross Service.
Joseph F. Coughlin,	469th Cons. Squadron, Air Service, U. S. A., A. E. F.
Alexander W. Beckett,	101st Regiment, Engineers, U. S. A., A. E. F.
William W. Walcott, M.D.,[1]	101st Regiment, Engineers, U. S. A., A. E. F.
John A. Doherty,[2]	Infantry, U. S. A., A. E. F.
James S. Kingston,	101st Regiment, U. S. A., A. E. F.
Samuel L. Ellsworth,	26th Regiment, Engineers, U. S. A., A. E. F.
Oscar R. Peterson,	601st Regiment, Engineers, U. S. A., A. E. F.
Joseph A. McCarthy,	302d Regiment, U. S. A.
Joel I. Connolly,	U. S. Public Health Service.
Allen M. Symonds,	U. S. Naval Service.
William A. Clark,	303d Regiment, Engineers, U. S. A.
Stanley H. Osborn, M.D.,	Medical Officers' Reserve Corps, U. S. A. A. E. F.
Josephine M. Washburn,	U. S. Naval Service.
Ernest R. Bower,	Hospital Corps, U. S. A.
Katherine Marden,	Sanitary Bacteriologist, U. S. Public Health Service.
Howard D. Williams,	Medical Corps, U. S. A.
J. Chester Cressey,	U. S. Naval Service.
John Crawford,	24th Regiment, Infantry, U. S. A.
Edward Wright,	Sanitary Corps, U. S. A.
Walter D. Lowell,	U. S. Naval Service.
Warren J. Scott,	U. S. Naval Service.
Francis Howden,	Sanitary Corps, U. S. A.
Walter E. Merrill,	Sanitary Corps, U. S. A.
George L. Drury,	Veterinary Corps, U. S. A.

In addition to the loss of personnel due to those actively entering service, the extreme measures adopted by the medical section of the Council of National Defense to stimulate medical recruiting induced in the medical personnel of the Department, in common with other health departments throughout the country, a condition of mental un-

[1] Died in France March 16, 1919, from disease contracted in line of duty. [2] Killed in action.

rest and uncertainty as to whether or not it was their duty to drop their civilian obligations and enter military service, which greatly interfered with the morale of the entire Department.

The medical department of the army, after numerous conferences with representatives of the State health authorities of the country, recognized the military necessity of maintaining civilian health departments by declining to commission officers of State health departments without certification from the head of the Department that their entering upon military service would not handicap the work of the health department. On this ground, upon reference by the Surgeon-General's office, the issuance of commissions to several medical officers of this Department was deferred for several months. Following the subsidence of the influenza epidemic, several district health officers were about to enter active military service when the cessation of hostilities stopped all inductions into military service.

Aside from the direct effect upon the Department of so many of its personnel entering the military service or awaiting release for entering into such service, the war has in many other ways handicapped the normal progress of health activities throughout the Commonwealth. Practically all new hospital construction has been stopped by action of the Federal authorities. The insistent call for nurses for military service has seriously curtailed public health nursing throughout the State, and stopped nearly all extensions of such service among the cities and towns of the State. The large number of physicians in the Commonwealth from the staffs of tuberculosis institutions and clinics, prenatal and postnatal clinics, and of school physicians, etc., entering military service has seriously handicapped health activities during the past year.

The Development of the Venereal Disease Campaign.

Although in certain respects, notably in establishing venereal disease clinics, the shortage of trained physicians due to military enlistment has handicapped progress in venereal disease treatment, on the whole the state of war has wonderfully stimulated the progress of the venereal disease campaign, particularly in lines of education and prevention.

The most encouraging development has been the close interlinking of the venereal disease activities of the War Department, the United States Public Health Service, and the Commission on Training Camp Activities with those of the State health departments of Massachusetts and the other New England States.

The coming of peace cut short many lines of venereal disease educational work among draftees and student army training corps units

which had been planned to be carried out by co-operation between military and civilian health authorities under the able leadership of Maj. Alec N. Thomson, M. C., U. S. A.

By special detail Major Thomson acted as director of the Department's Subdivision of Venereal Diseases for a period of several months, in addition to supervising the venereal disease prevention work for the Northeastern Department of the army.

The venereal educational film of the War Department, "Fit to Fight," has been exhibited in most of the large cities of the State by the Department. Large and appreciative audiences have witnessed this film, and the educational benefits of the lessons of the dangers of venereal disease imparted thereby are believed to be of great value.

The response of the medical profession to the system of reporting venereal diseases has been very encouraging. Illustrative of the practical preventive value of the venereal disease campaign is the large number of patients of both sexes whose names have been reported to the Department by physicians, under the regulations, because of lapsing treatment while still in an infective stage, who have been "followed up" by the Department and placed under regular treatment up to the point of cure or non-infectivity.

During the year the manufacture of arsphenamine has advanced from the experimental to the factory stage, and is now rapidly approaching a regular quantity production sufficient to fill all the needs of the State.

All phases of State venereal disease work have received great stimulation from the passage of the Kahn-Chamberlain law, which divides $1,000,000 annually among the States for anti-venereal disease work under regulations laid down by the Federal Public Health Service, and conditional upon each State appropriating an equal amount. Under the provisions of this law Massachusetts receives $36,000 annually for venereal disease work.

Child Hygiene and Prevention of Infant Mortality.

No part of public health activities deserves more careful study by the health administrator than child hygiene. No phase of public health work, intelligently and intensively cultivated, yields more immediate and permanent returns. Nothing connected with preventive medicine contributes eventually so greatly to the economic and social growth and prosperity of a Nation or State as effective work in child conservation.

The best national life insurance a country can carry is to have its population on the increase rather than at a standstill or declining.

The events of the past four years have shown the vital importance of "man power" conservation in such fashion that no elaboration of argument is needed to demonstrate its importance to national efficiency and prosperity.

Reduced to its simplest terms, the importance of infant and child hygiene may be stated as follows: —

1. One of the most fundamental, if not the most important of all, factors in assuring continued national existence and prosperity is a healthy development and increase of human resources.

2. Only three factors can be reckoned upon to produce this result: —

(*a*) Immigration.

(*b*) A high birth rate.

(*c*) The reduction of mortality in the juvenile and young adult age groups.

Examining these three factors and applying them to the United States, we reach certain conclusions: —

1. Immigration of young adults, with a high birth rate among recent immigrants, has been the great source of our expanding population throughout our history, and in an increasing degree in the past fifty years.

2. The indications are that this factor will decrease in the future.

3. In common with practically all Caucasian nations the native birth rate of *recent immigrant* parental stock, as well as of "American" parental stock, is constantly declining; hence we can rely less and less confidently upon native births providing such a large surplus reservoir of population that the nation in the future can afford to be as careless of the conservation of its human assets as it has been in the past.

4. If the validity of the three previous conclusions is granted, we cannot escape the conclusion that now as never before does the conservation of human life, at least in the productive periods, become a matter of deep and vital national concern.

5. Surveying the entire field of life conservation in its relation to the future population, two things at once become evident: —

(*a*) That nowhere is the national loss in actual or potential population so great as in the age group under five years.

(*b*) That in no other age group can so much of this waste of vital assets be stopped so quickly, efficiently and cheaply by tried and efficient measures as in this same age group.

In this new era of our national life the conservation of child life becomes a matter of vital concern to every citizen, and the saving of thousands of children's lives, now lost annually in this country through ignorance and economic handicaps, can be made by proper precautions.

New Zealand is a small country, and in common with some other countries it has for decades faced the problem of a steadily declining native birth rate. As a nation it has attacked seriously the problem of salvaging its infant and child assets to a degree that no other country has even remotely approximated, and has cut its infant death loss in half in the past fifteen years.

For the past year and a half this Department, through its child conservation committee, has consistently, although with meager personnel and funds in comparison with the size of the problem, endeavored to induce the cities and towns of the Commonwealth to inaugurate the same simple methods for infant and child life saving that have proved so effective in many other parts of the world as well as in New Zealand. The need for these measures is doubly great just at present, for the direct and indirect effects of war conditions tend to lessen the natural increase by birth and to increase the fatality of infants' and children's diseases. The results of the campaign are greatly encouraging as to immediate accomplishment, and full of promise as to the future.

In general it may be said that the greatest instrument in our hands for child conservation is instruction, — personal contact rather than long-range instruction; lessons by demonstration rather than by precept or pamphlet; teaching the potential and prospective, as well as the actual and perplexed, mother as to the "what and why" of infant and child hygiene, given her in her own home or at convenient near-by centers in company with neighboring mothers, given her on a plane of equality and friendship by one who has her welfare at heart. This type of information in "mother craft" saves lives, and this type of practical hygiene can best be imparted by the trained child-welfare or public health nurse.

In the last annual report of the Commissioner the organization of the Department's child conservation committee and the plan adopted for this work were explained in some detail. During the year the plans for surveying all communities have been carried out with a high percentage of completeness and with very encouraging results from the standpoint of the increased interest in child welfare work exhibited by various cities and towns, the amount of money appropriated both by city and town governments and by private organizations, and in the number of new nurses placed in the child welfare field. It is felt that the work so well begun by the child welfare committee has now demonstrated its usefulness to such a degree that, while such intensive surveys will not be necessary in the future, the State Department of Health should maintain competent experts in child welfare work to correlate and supervise activities in these fields throughout the State.

Detailed reports upon this work have already been published in the monthly bulletin of the Department in a special double issue (September–October), and a review of it is given in the report of the Division of Hygiene.

Legislation recommended.

1. A resolve relative to an investigation by the State Department of Health and the Metropolitan Water and Sewerage Board, acting jointly, of the water-supply needs of the inhabitants of the Commonwealth.
2. A resolve authorizing the State Department of Health to investigate and to carry on preventive work against cancer.
3. An act relative to the cold storage of articles of food.
4. An act relative to the duties of members of boards of health acting as inspectors of slaughtering.
5. An act relative to the slaughtering of neat cattle, sheep and swine.
6. An act providing for the appointment of a deputy commissioner of health.
7. A resolve providing for an investigation of the medical inspection of schools of the State by the State Department of Health, the State Board of Education and the State Commission on Mental Diseases.

Activities of the Divisions of the Department.

Division of Administration.

The work of the Division of Administration has continued on similar lines to that of previous years. In the Massachusetts State Department of Health the Division of Administration does not in any sense act as a general supervising organization for the other divisions of the Department, but consists of two subdivisions where the accounts and records of the Department are kept. The steady growth of the work of the Department has thrown heavy additional work upon those in charge of the accounts and files, which has been carried on without additional assistance. The emergency requirements due to the influenza epidemic were very heavy and involved a great deal of overtime work from all the employees of the Division, as well as from the Divisions of Communicable Diseases and Hygiene.

I wish to take this opportunity to express my appreciation of the splendid spirit in which all the employees of the different Divisions of the Department gave so unsparingly of their time and strength throughout the continuance of the epidemic.

Division of Sanitary Engineering.

X. H. Goodnough, C.E., Director.

The applications received for advice as to water supply, sewerage, etc., during the past year have numbered approximately the same as in the previous year, but there has been a considerable difference in the general character of the work. Very little work has been undertaken by cities and towns in the introduction or extension of water supplies and sewerage systems, except in cases of emergency, but an unusual number of applications for advice as to water supply and sanitation of military and other camps have been presented for the advice or approval of the Department.

The winter of 1917–18 was far more severe than any experienced in Massachusetts since the general introduction of water supplies was begun, and a great many service pipes and even supply mains became frozen. After the first severe cold in December, 1917, faucets were quite generally allowed to run continuously. Under these conditions reservoirs became depleted, and there were serious shortages of water in many places. Water consumption in the spring months was much greater than in the same months of the previous year, due largely to leakage caused by the freezing of pipes. It has not been practicable in many places to make the repairs and improvements required to reduce the consumption to the normal amount.

At Lawrence the distributing reservoir, holding about 40,000,000 gallons, became nearly exhausted toward the end of the winter, notwithstanding that the filters were operated to their greatest capacity and all the water practicable was obtained from the adjacent towns of Andover and North Andover. On account of this situation the Department called a conference on October 23 with the authorities of the city and advised them that the covering of an additional portion of their filters was essential in order to make provision for an adequate water supply during the coming winter. The city water commissioner carried through the covering of the filter promptly and efficiently in season to put the filter in operation at increased capacity before the beginning of cold weather. The Department has recommended to the city government that it make still further provision for the enlargement of its filtration works in 1919, so as to provide an ample supply of filtered water for the city's immediate needs and discontinue the purchase of water from Andover and North Andover.

An important decision relating to the question of fishing in public water supplies was given by the Supreme Court on February 9 in the case of Commonwealth *v.* Hyde, involving the power of the State

Department of Health to regulate or absolutely prohibit fishing in waters used as sources of water supply under the provisions of section 113, chapter 75 of the Revised Laws. The court in this case found that the regulation of fishing, and even its absolute prohibition, could not be deemed unreasonable in the circumstances.

Because of the financial, material and labor restrictions imposed by war conditions little or no progress has been made in the works for the treatment of sewage and manufacturing waste for the relief of the polluted streams of the State, although a number of existing works for sewage disposal urgently require extension or improvement.

The quantity of manufacturing waste produced at many of the mills has increased very greatly during the year, but, by reason of the difficulty of obtaining labor and materials, very little has been done toward the treatment of such wastes.

In addition to the regular work of the Division, several special requirements which were imposed upon the Department by the Legislature of 1918 have been included in the duties of this Division. These were: —

1. Improvement of Hale's, or River Meadow, Brook in Lowell. (Chapter 92, Resolves of 1917, and chapter 24, Resolves of 1918.)
2. The use of the summer flow of the Ipswich River for the water supply of Salem and Beverly. (Chapter 73,. Resolves of 1917, and Chapter 26, Resolves of 1918.)
3. A plan for a system of sewerage and sewage disposal for the town of Ayer. (Chapter 58, Resolves of 1918.)
4. Investigation of the cost of a sewerage system to prevent the pollution of the Mystic Lakes. (Chapter 34, Resolves of 1918.)

The necessary surveys and investigations relative to the improvement of Hale's Brook and for the design of a sewerage system for the town of Ayer were completed near the end of the year, and work has been begun upon the question of the use of water from the Ipswich River; but with the very limited engineering force available to the Department it has not been practicable to complete this work or begin as yet the investigations relative to a sewerage system for the protection of Mystic Lakes.

Under chapter 182 of the General Acts of 1918 surveys and studies relating to the determination of the ownership and area of lands benefited by the improvement of the Neponset River have been continued and are likely to be completed soon after the end of the year.

The law enacted by the Legislature of 1918 for the protection of the public health in the vicinity of Alewife Brook in the towns of Arlington and Belmont, and in the cities of Cambridge and Somerville (chapter

88, General Acts of 1918), relates to the protection of a tributary of the Mystic River draining a considerable area in the municipalities named, including a large area of former salt marsh made available for reclamation by the dam at Cradock Bridge. The investigations to determine the sources of pollution of this stream had not been completed at the end of the year because of inability to secure the necessary engineers to do the work.

Under the provisions of chapter 289 of the General Acts of 1918, relative to the improvement of certain low lands, the Drainage Board created by that act has been organized, and work upon the investigations therein authorized has been begun. The act is an important one and is in line with the legislation already adopted in many other States designed for the development and utilization of wet lands for agricultural or other purposes, or for their drainage for the protection of the public health in case such work shall be found necessary or useful. The act provides in general that proprietors of low lands desiring to improve them for any purpose may secure the advice of the Drainage Board as to the advisability and cost of the proposed improvement without expense to themselves; and if the improvement proves likely to be sufficient to warrant the cost, the work is to be carried out by the county commissioners and assessed upon the lands benefited through the cities and towns in which they are situated.

Division of Water and Sewage Laboratories.

H. W. Clark, Director.

During the year 1918 the usual chemical, bacterial and microscopical examinations of samples from the water supplies, rivers, etc., of the State were made, this work necessitating the making of 4,206 chemical, 1,450 microscopical and 1,750 bacterial analyses. Studies of sewage areas, the purification of sewage, trade wastes, purification of water, examinations of shellfish, etc., called for 2,396 additional chemical and 2,286 bacterial examinations.

Special work was done in connection with the purification of the water supplies of Lawrence, Beverly and Salem.

Studies were made of the use of chloramine in connection with bleach for the purification of water.

Tests were made in regard to the treatment of water with a new pattern of ultra violet ray lamp.

Investigations were made of the disposal and purification of manufacturing wastes from many industrial works, and special studies were made in regard to several of them upon which reports were made to the Department.

Continuous studies were made during the year of the Miles acid process for the treatment of sewage; of various forms of activated sludge tank work; of the method of flow of liquids through activated sludge or sedimentation tanks, together with studies of the control of such flow by baffles, etc.; and quite extensive studies were made in regard to the comparative amount of recoverable material of value resulting from the treatment of sewage by the Miles acid process, activated sludge tanks and trickling filters.

During the year further work was done in regard to the removal of color from water, and special bacterial studies were made of certain ground waters in the State.

On account of the war it has been hard to obtain competent assistants and to keep them when obtained. Several men left our employ during this year to enter the government service or to accept more highly paid positions in industrial works.

Division of Communicable Diseases.

J. S. Hitchcock, M.D., Director.

During this year the State has had a remarkably small number of outbreaks of disease in epidemic proportions.

We believe, although arguing by exclusion only, that the system of using our endemic index as an alarm clock has had this effect. In negative corroboration of this, the facts in regard to measles are of interest. Because of the very early infectivity of this disease its spread is largely in advance of information obtainable from the use of the endemic index, and theoretically we should get no results therefrom. Apparently we get none. Epidemics of measles have appeared in the usual number and size. Influenza also leaps all our barriers in a manner quite like measles. May not this indicate that its communicability is, like measles, most active in very early, practically presymptomatic, stages?

There were only 90 instances where outbreak notices were sent to District Health Officers, divided as follows: —

Diphtheria,	28
Epidemic cerebrospinal meningitis,	1
German measles,	5
Lobar pneumonia,	1
Measles,	20
Scarlet fever,	25
Smallpox,	1
Typhoid fever,	8
Whooping cough,	1

The *diphtheria* outbreaks totaled 441 cases, with 77 as the largest single instance.

In the case of *measles*, 10,624 cases were reported from 33 cities during the months of February, March and April. Approximately 29,000 cases were reported from the State during the year.

Scarlet fever appeared in 25 outbreaks, with a total of 600 cases. The largest, composed of 124 cases, appeared in Holliston in August and September, and was milk-borne.

An outbreak of six cases of *smallpox* appeared in Marlborough in February, due to the admission of an unrecognized case into a general hospital.

At Camp Devens in Ayer a large number of malaria carriers was found, and in pools in surrounding towns numbers of anopheles mosquitoes. This combination threatened an outbreak of malaria in the civil population unless prevented. The Governor and Council appropriated $1,000 to be applied in drainage work for this purpose.

The overshadowing epidemic of the year was influenza. On or about August 28 reports were received of cases among naval men at Commonwealth Pier, Boston. As influenza was not reportable, information from ordinary sources was meager, but early in September the Department issued a public warning of the probable approach of a general outbreak. By September 19 the disease was firmly intrenched in a very fatal form in several towns and cities in the eastern part of the State, and investigation showed great need for doctors, nurses and hospital accommodations. These were obtained and distributed as rapidly as possible to points where the need was greatest.

The outbreak spread rapidly and covered the entire State. The only successful barrier was a strict quarantine established *well in advance* of the first appearance of the disease in the immediate vicinity, and strictly maintained. The only instances of this procedure were in certain schools and institutions. As long as they maintained a strict quarantine they escaped. With the appearance of the first case all attempt at protection by isolation or other preventive measures was ineffectual, and the usual percentage was affected.

Influenza figures are not completed at date, and can never be accurate in the matter of the number of cases of the disease. Up to December 1, there are estimated to have occurred 400,000 cases and 12,000 deaths. It is needless to report that an epidemic of this proportion, with this fatality and rapidity of extension, strained every public and private health agency, at times nearly to their limit of cohesion.

The venereal disease program, announced last year, has been launched. The addition of gonorrhea and syphilis to the list of reportable diseases became effective on February 1. From then to Decem-

ber 1 a total of 10,047 cases, 7,036 of gonorrhea and 3,011 of syphilis, have been reported to this Department. A subdivision of venereal diseases has been established. Of the 16 clinics and 3 subclinics planned, 11 clinics and 1 subclinic are in operation, and the remainder are in different stages of completion. An instance of the usefulness of work in this subject is shown in its results with persons lapsing from treatment through negligence or intent. Of 1,182 such cases, 579 were reclaimed and 338 are still being followed up, while only 265 have been lost sight of. That 579, or 50 per cent, of the most dangerous, because either careless or vicious, type of venereal cases were brought back to treatment through the guiding efforts of this subdivision is a remarkable record.

The educational side of the work has been active. A total of 98 lectures and moving-picture exhibits have been given to about 75,000 people. The film exhibit "Fit to Fight," purchased from the War Department, has been shown 54 times in 23 cities and towns to about 60,000 people.

The co-operation between this Department and the local boards of health, the courts and the military and civil organizations and societies engaged in different phases of the problem has been very complete and satisfactory.

A subdivision of tuberculosis has been established. The volume of work involved in the general supervision of the 20,000 or more active cases of this disease in the State made such a specialization advisable.

The construction of county tuberculosis hospitals was abruptly halted by the action of the capital issues committee. They decreed that, as a measure for the conservation of capital, work on the Essex and Middlesex institutions should entirely cease, and after delays they permitted the work on the Barnstable, Bristol, Norfolk and Plymouth institutions to proceed. Our whole protective program has therefore been delayed for approximately a year, although our tuberculosis death rate is still increasing and the need for these institutions is urgent.

A survey of Barnstable County to determine the prevalence of tuberculosis, made in April, proved the local disease demand for a hospital.

A survey of the city of Cambridge was interrupted by the influenza epidemic, but has been resumed.

The dispensaries in the Northeastern District have all been visited by a representative of this subdivision for the purpose of standardizing their records. During this year it is planned to cover the entire State with this work.

About 1,100 positive and suspected cases were reported by local exemption boards and military cantonments. Of these, 615 were brought to our attention and placed under treatment very much

earlier by this procedure than they would have been in ordinary circumstances. The others were already on record.

The intensive campaign against typhoid fever has been continued with success. Eight carriers have been located and guarded against. During the past year 406 less cases were reported than during the year previous. The case incidence was 0.29 in each thousand population as compared with 0.4 in each thousand during the previous year. Fall River continues to have more than its share of cases, but has reported less than 60 per cent of its last year's record.

One milk-borne outbreak, totaling 32 cases, occurred in Marlborough in August and September. This was found to be due to a carrier employed in connection with a milk route.

This year has seen the addition of eight nursing assistants to our field force, one to each health district. They have been at work for only three months. Their value as an organizing and directing force was very clearly demonstrated during the influenza epidemic.

The scope of the work of the District Health Officers and their nursing assistants continues to broaden, — to get away from detail and specialization and into generalization. Their influence in their districts is being felt and appreciated more and more. Their duties are arduous and trying, and we are proud of their record.

The number of examinations made in the diagnostic laboratory was approximately 18,800, about 3,500 less than during the previous year. School outbreaks of diphtheria were markedly fewer, and the number of examinations correspondingly less. Of the 396 cultures for typhoid examined, 36 were positive and 8 carriers of the disease were located. This increased our knowledge and power over the sources of typhoid fever, and our typhoid rate this last year seems correspondingly lower.

The determination of type in pneumococci has been carried on steadily. There have been 997 specimens of sputum examined, resulting in the type determination in 683 instances, and proving the absence of pneumococci in 314.

The laboratory staff has instructed 20 visitors in various branches of the work during the year, and has also given a war service course to eight college graduates from Smith, Simmons and the Massachusetts Institute of Technology.

Division of Food and Drugs.

H. C. Lythgoe, Director.

The actual work of the Division of Food and Drugs has been greater during 1918 than during the preceding year. During the eleven months of 1918, 10,724 samples have been examined; 324 cases

have been prosecuted, the total fines amounting to $7,900.10; and 75 confiscations have been made, the weight of confiscated articles amounting to 96,864 pounds.

There were a number of cases of adulterated milk shipped into the Commonwealth from other States, and a number of violations of the laws regarding the sale of eggs. It was found that, in general, egg dealers were selling eggs of all descriptions as fresh eggs, and the false advertising law was used successfully in curbing violations of this character.

A special investigation of the character of meat used in sausage factories proved that it was much better than that used in former years.

An investigation was made of the character of ice cream sold; and while the percentage of fat corresponded to the requirements of law, it was found that the samples taken were very light in weight, due to the introduction of large amounts of air during the process of manufacture. Ice cream is sold by volume and not by weight, and air is naturally the cheapest of ingredients.

At the request of the district attorney of Middlesex County a special investigation was made of the water used in ice-cream parlors for moistening the scoops. The amount of bacteria found in the water was surprisingly low, in no case reaching the limit set by local board of health regulations concerning the maximum figures for bacteria content of ice cream.

The Department, through the Division of Food and Drugs, was called upon to co-operate to some extent with the Food Administration, particularly in connection with cold-storage extensions.

Considerable trouble was experienced in placing arsphenamine manufacture upon a commercial basis. At the present time all difficulties have been overcome, and nearly 3,000 ampoules have been distributed, with no reports of detrimental physiological action. The processes of manufacturing and bottling the drug have been changed, making an increased yield possible. Present indications are that the Division will be able to turn out 120,000 doses during the coming fiscal year. Special care is being taken in having duplicate physiological tests of the product made in separate laboratories, so that the danger of a mistake in the final testing is reduced to a minimum.

Division of Biologic Laboratories.

M. J. Rosenau, M.D., Director.

The work of the Division of Biologic Laboratories was carried out in the face of unusual difficulties during the fiscal year of 1918. This was caused by increased activities, increased demand for products, changes

in personnel, the difficulty in obtaining certain supplies, and the strain of finance caused by war conditions. Several emergencies had to be met, which taxed the capacity of the laboratories to their utmost. There was a sudden and unusual demand for diphtheria antitoxin during the summer time, for vaccine virus in the spring, and for antimeningitis serum during the cold season. The principal new activity of the Division consisted in the testing of arsphenamine.

The changes in personnel at the Antitoxin and Vaccine Laboratory at Forest Hills, caused by war conditions, became a matter of deep concern when the nature and importance of the products made at that laboratory were taken into account. The financial situation was bothersome during the fiscal year, for it soon became evident that even with the strictest economy it would be impossible to make the budget meet the increased cost of labor and supplies.

As an example of the difficulties the laboratories had to contend with, we may cite the fact that it has become impossible to obtain dialyzing paper for the purpose of concentrating diphtheria antitoxin. This paper was formerly made in Belgium, and since this source of supply has been cut off it has become impossible to obtain paper of equal quality.

The following is a summary of the work done both at the Antitoxin and Vaccine Laboratory at Forest Hills, and the Wassermann Laboratory at Boston: —

	1918.	1917.
Vaccine virus (doses),	209,835	180,521
Typhoid prophylactic (doses),	37,322	71,893
Paratyphoid vaccine (doses),	2,850	2,723
Typhoid-paratyphoid (doses),	27,315	16,143
Diphtheria antitoxin (doses),	206,937	218,604
Antimeningitis serum (bottles),	4,035	2,005
Pneumococcus serum: —		
Type I (bottles),	363	60
Type II (bottles),	366	97
Schick outfits (bottles),	6,400	3,100
Toxin antitoxin (doses),	426	–
Wassermann tests,	29,000	28,000
Complement fixation tests for gonococcus,	1,200	–
Tests for glanders,	1,051	1,330
Tests for rabies,	56	67
Pathological examinations,	25	13

The Division has again co-operated with the Bureau of Animal Industry in making diagnostic tests for glanders, rabies and other infections of animals.

The Division has assisted both the army and navy in different ways; thus 2,732 naval aviators were tested for the Wassermann reaction, with 12 positives; and 1,200 were subjected to the complement fixation test for gonococcus infection, with 7 positives. We also furnished to some of the army and navy establishments in Massachusetts quantities of diphtheria antitoxin, antimeningitis serum, vaccine virus and other products to meet special needs.

Perhaps the most important activity of the Wassermann Laboratory has been in connection with the standardization of the Wassermann technique. Representatives from eleven of the largest laboratories in the State were called together by the Commissioner of Health. The technique used at the Wassermann Laboratory was adopted as a standard method of procedure for all laboratories performing this test throughout the Commonwealth. The Wassermann Laboratory has also been able to aid in the State venereal program in various ways.

The work of the Division has been increased, the number of its products multiplied, and the quality of its service improved.

Division of Hygiene.

M. E. Champion, M.D., Director.

Chief among the outstanding pieces of work of the year was that accomplished through the child conservation committee of the Department. The appointment and organization of this committee was described in last year's report. It is difficult to summarize this work, but in brief an attempt was made through the eight nurses employed by the committee to make a survey of the child conservation resources of every city and town in the State, with the exception of some of the small towns having no particular problem to face. Figures compiled Sept. 1, 1918, show that 220 towns were surveyed, including 92 per cent of the population of the State.

The weighing and measuring campaign, though not carried on directly by this Department, was encouraged as an aid in publicity for child welfare. Incomplete reports give 129 cities and towns as having carried out the test. A rough estimate of the concrete results of the children's year campaign to Sept. 1, 1918, may be given as follows: —

Amount of money appropriated by cities and towns,	$25,680
Amount of money raised by private organizations,	28,250
	$53,930

Amount of money fairly sure in prospect,	$11,500
	$65,430
Number of nurses actually employed,	31
Number of nurses authorized but not secured,	15
	46
Number of nurses fairly sure to be placed,	5
	51

The policy of the entire year's campaign has been to stimulate the different municipalities to take care of their own problems, at the same time lending them every assistance possible. Occasionally, nurses have been loaned for a longer or shorter period to help in the organization of new work in some city or town.

Our prenatal letters have apparently filled a real need. Replies from mothers are frequently received voicing their appreciation. Approximately 1,700 sets of the letters have been sent out this year.

During the greater part of the summer, through the courtesy of Miss Donham of the Garland School for Homemaking, this Division maintained an exhibit on a food trolley which traveled over the eastern part of the State. A great many people were reached in this way at comparatively little expense.

Various new pamphlets were issued, mostly on nutritional subjects, reprinted from the monthly bulletin. One on the care of the baby in hot weather proved very effective. An outline of a course on child welfare, designed for use in vocational schools for classes of girls and young women, was prepared with the hearty approval of the director of vocational work of the State Board of Education.

The monthly bulletin has been altered in form and appears under a new name, "The Commonhealth." A special double number of this was issued for September–October, dealing with the problem of child conservation in its various aspects.

Our lecture service was continued during the year, a total of 587 lectures having been given. This number would have been much larger if it had not been for the absorption of the public in war problems of other kinds, and for the interruption to our work caused by the influenza epidemic.

The policy has been continued of holding health weeks throughout the State, at which our exhibits are shown and talks on various health problems are given by different members of the staff. A nurse accompanies the exhibit. Her most important duty is to reach the mothers and children through demonstrations and talks on child hygiene.

Future Office and Laboratory Space for the Department.

As was foreseen at the time of occupancy, the present administration quarters of the Department have already proved too small. The rapid development of the venereal disease campaign has resulted in the employment of a personnel for whom no adequate quarters are available. The removal of many of the temporary war emergency offices from the State House has relieved the strain of demands for space upon the State House Commission. They have promised to endeavor to make such necessary adjustments within the near future as will insure adequate office space for the Department.

In the last annual report the Commissioner commented upon the request of the Harvard Corporation to the Department to vacate as early as possible the building at Forest Hills now occupied by the Antitoxin Laboratory, but owned by the University and desired for their own use.

During the year the special committee on laboratories of the Department has sought in all directions to find a suitable tract of land near Boston for this purpose. The task is a most difficult one. Certain fundamental requirements as to accessibility, availability of gas, electric current and water service are absolutely basic in a problem of this sort. On account of the number of animals necessary, considerable acreage beyond that needed for the buildings is very necessary to furnish exercise ground for horses, etc.

After looking at all sites suggested or found, the committee decided that the two most favorable sites in the vicinity of Boston, aside from all questions of present ownership, where land suitable to the purpose existed, were on the grounds of institutions already belonging to the State. One of these sites, and the best for our purposes, the Boston State Hospital for the Insane, is stated by the Commission on Mental Diseases to be already so completely pre-empted for buildings in their plans for future expansion that no space is available.

The problem is a most pressing one, regardless of the insistent demands of the Harvard Corporation for our vacating the present quarters. Ordinary foresight and prudence demand that a much larger number of horses should be kept for the production of antimeningitis serum and diphtheria antitoxin, but no space is available in the present stables for additional horses.

Furthermore, the policy of housing our Wassermann Laboratory as a rent-free tenant at Harvard Medical School, while most generous on the part of the University and of tremendous service to the State, is one that cannot in fairness to the University be expected to be continued indefinitely.

The separate laboratories maintained at the State House and at Lawrence by the Department for the water and sewerage investigations should also eventually be housed in the same building as the biologic laboratories.

Prevention and Control of Cancer.

An appropriation of $3,000, to be expended for the prevention and control of cancer, is being asked for. Such an expenditure is justified for the following reasons: —

1. *The Importance of the Work.* — There were 4,051 deaths in Massachusetts in 1917 from cancer. In this State 1 in every 8 women and 1 in every 14 men over the age of forty die of cancer. A large proportion of these deaths might be prevented by early treatment.

2. *The Desirability of Scientific Accuracy in Diagnosis.* — It is important to know after an operation has been performed whether or not the patient really had cancer. This can be definitely decided only by pathological examination. An apparently benign growth may prove, on careful microscopic examination, to be cancerous. If this is determined at once a more extensive operation can often save a life which otherwise would be sacrificed through ignorance of the facts.

3. *Education of Public.* — Such a service enables surgeons to make more accurate diagnosis by having their results checked up by microscopic examination. It also makes the public appreciate the need of careful medical supervision to detect early signs of cancer, in that the value of such supervision can be proved by the concrete evidence of the laboratory. Anything which tends to get the patient to the physician early, and which tends to get the physician to take no chances on suspicious growths, inevitably will help to reduce our cancer death rate.

For the past two years the Cancer Commission of Harvard University has furnished both space and expert cancer microscopists to the Department for the free examination of any suspected pathological tissues for hospitals and surgeons throughout the State.

The Commission now feels that the life-saving value of this work has become sufficiently well demonstrated, and that the State should assume a part of the expense. I feel that their contention is only fair, and therefore recommend that $3,000 be appropriated as remuneration in part for the expert services of the cancer laboratory of the Harvard Commission, and for extending the facilities of this laboratory to the physicians and surgical hospitals of the State.

4. *Economy.* — Under the scheme proposed the Department can save the overhead expenses of a laboratory of its own because of the

close co-operation possible between the State Department of Health and Cancer Commission of Harvard University, whereby laboratory facilities available to the latter are placed at the service of the State Department of Health.

Water Supply Problems.

In the opinion of the State Department of Health the time has come when it is necessary that a comprehensive and thorough investigation be made of the water-supply needs of the inhabitants of the Commonwealth. Many of our cities and towns having inadequate and unsatisfactory water supplies are forced to seek new sources in isolated efforts.

The contrast between the water-supply conditions of such municipalities and of those supplied with metropolitan water is so marked, and the waste of piecemeal investigation and improvement so great, that the Department of Health has entered into a conference with the Metropolitan Water and Sewerage Board to consider the situation. As a result of this conference a resolve has been prepared authorizing an investigation by the State Department of Health and the Metropolitan Water and Sewerage Board, acting jointly, of the water-supply needs of the Commonwealth, which will be submitted to the Legislature of 1919.

It is interesting to note in this connection that in the original investigation as to the water-supply needs of Boston and neighboring cities and towns, which resulted in the establishment of the Metropolitan Water Board, it was calculated by the engineers of the State Board of Health in their report of 1895 that in twenty years' time, if the growth of population continued at the same rate, the whole question of the water supply would need reconsideration from the standpoint of enlarging the possible available supplies and increasing the number of communities to be furnished metropolitan water. In view of the conditions in many of the districts of the State, it is important that a thorough study be made of the whole problem of water supply in all portions of the State, but especially in the areas herein described, in order that an ample supply of good water may be made available for the use of the inhabitants at all times, and that the danger of shortage of water supply or of injury to the public health from the use of inferior water supplies may be avoided. These questions are of the utmost importance. A public water supply under modern conditions is by far the most important of all public services. Upon it depends the means for extinguishing fires, all too common under our New England conditions of building. No article of diet is as essential to the health of the individual as pure water, and none is capable of causing more

widespread and serious injury to the public health than drinking water containing injurious substances. A pure water is also valuable for mechanical uses and for many manufacturing purposes, and the possession of or a right to have an excellent water supply is a most important asset to any municipality. The standing of Massachusetts water supplies has thus far been high, and it is important that this standard be maintained. With the rapid growth of population in the metropolitan district, and in other great industrial areas in the State, the enlargement of local water supplies is constantly necessary, and the available drainage areas suited to the purpose of providing public water supplies are becoming measurably restricted.

There will undoubtedly arise in the near future serious questions as to grants of new sources of water supply in many parts of the State, and the interests of all concerned require that the selection and development of new sources shall be made in the light of full information as to circumstances affecting the sources which are found to be available, and their appropriateness for the purpose for which their use is proposed. A thorough study of the whole problem would furnish the information necessary for the selection of the most appropriate sources of water supply for the various municipalities, with due regard for the needs and interests of the other cities, towns and persons which may be affected thereby. Much information of value in connection with such an investigation, including records of rainfall, flow of streams, yield of watersheds, the character of their waters and means for their protection, has been accumulated by this Department in connection with its general oversight of inland waters under existing laws, and much additional information as to water supply in a large part of the State has been gathered by the Metropolitan Water and Sewerage Board in an experience of many years in the construction, maintenance and operation of the metropolitan waterworks. It would undoubtedly be advantageous to combine the two departments in such an investigation as is here proposed, thus making the experienced engineering staffs of these departments available for the general direction of the work, and it is probable that, notwithstanding the far greater number of sources requiring careful consideration, and the greater cost of such work at the present time, an appropriation no greater than that which was necessary in connection with the original metropolitan water supply investigation will be sufficient for the work. The Department therefore recommends an appropriation of $50,000 for carrying out the work herein proposed, which can probably be completed within two years.

In water-supply questions it is peculiarly necessary that far-seeing plans be made as to future development. Ultimate plans for future

conservation of water supplies in Massachusetts should rest upon the premise of the possible maximum future population of the State being limited by the possible future extension of adequate water supplies. From this it follows that every possible future source should be studied and methods for its conservation put into effect.

School Hygiene.

As a result of the draft examinations we now know that from one-quarter to one-third of those examined were suffering from physical defects. Most of these defects could have been corrected or prevented in childhood if proper medical examinations, followed by appropriate hygienic medical or surgical treatment, had been carried out, and proper physical education instituted. In this, as in other things, foresight is better than hindsight, and hindsight better than no sight at all.

To forestall such a state of affairs in the future, thus insuring that our children be physically fit, whether for tasks of peace or of war, is the present duty of those interested in the health and education of the child. Two methods of attack have been proposed. One is through extension and standardization of the present medical inspection law, which would make it obligatory on all cities and towns to furnish, to an extent necessary to properly carry out the work, school physicians and nurses and to provide modern teaching of hygiene. The other is through the universal establishment of instruction in physical education, so called, carried out consistently throughout the period of school attendance, and properly adjusted to individual needs and capacity of the child as determined by the periodic physical examinations.

Both these methods of attacking the problem depend for success on close co-operation between the two agencies interested, namely, the departments of health and education. The execution of the provisions of any such law or laws might well be in the hands of the educational authorities. Rules and regulations, on the other hand, should be promulgated only after the concurrence has been obtained of the other department most interested, namely, that of health.

In view of the great need for uniformity throughout the State, if such methods of school hygiene are to be effective, there should be central control provided for in any laws enacted on this subject; and under the circumstances, this control should rest with the State Board of Education and the State Department of Health.

Housing.

Housing conditions in this State are being investigated by a housing board, appointed in July, 1918, by the State Commissioner of Health. In view of the shifting of industries due to war conditions, the in-

creased cost of building, the scarcity of suitable dwellings in many cities and towns, and the growing public interest in the housing problem, it has been thought desirable to have this Department secure data bearing upon the fundamental relation between housing and health, in order that it may be prepared to give advice on this important matter. This investigation has involved not only general studies but local studies of density of population per acre and per building in representative cases, the operation of existing sanitary regulations, and the sufficiency or otherwise of available tenements.

The board has as chairman Prof. George C. Whipple of Harvard University, member of the Public Health Council, State Department of Health, its other members being drawn from the medical and engineering services of the Department, as follows: —

Dr. John S. Hitchcock, Director of the Division of Communicable Diseases.
Dr. C. E. Simpson and Dr. R. B. Sprague, District Health Officers.
Mr. X. H. Goodnough, Chief Engineer and Director, Division of Sanitary Engineering.
Mr. John S. Hodgson, Sanitary Engineer, Secretary.

The board was represented by the secretary at the recent Boston Convention of the National Housing Association.

Medical Social Service.

The recent epidemic of influenza has brought to the front the great need of some co-ordination and extension of the agencies designed to help persons temporarily unable to care for themselves through sickness. These persons do not need charity in the ordinary sense of the term, but temporary assistance may prevent them from drifting into the pauper class.

Medical social service is not an untried thing. The Massachusetts General Hospital and many other institutions have proved its worth. It is non-existent, however, in most of the smaller places, and nowhere are the different agencies properly co-ordinated.

Health departments in the past have not recognized, as a rule, any obligation in this direction. It is a serious question whether it is not a proper function of health departments, merely as a matter of preventive medicine, to start those temporarily disabled on the road toward health and usefulness, and away from chronic ill health and the pauper state. A careful study of existing agencies for medical social service and their relationship to the community should help to determine the above point and to clear up the subject in general.

Plumbing.

Because of the many questions continually arising in relation to the practice of plumbing, the adequacy of plumbing regulations, and the general problem of the distribution of water and removal of liquid wastes within buildings, a plumbing board was appointed by the State Commissioner of Health in September, 1918.

The board consists of Prof. George C. Whipple of Harvard University, representing the Public Health Council; Mr. James C. Coffey, member of the Board of Examiners of Plumbers; Mr. E. C. Kelley, representative of the Massachusetts State Association of Master Plumbers; and Mr. Thomas M. Wilson, representative of the New England Association of Plumbing Inspectors. The duties of this board are to consider the whole problem of plumbing laws in order to ascertain the feasibility of establishing a simplified and uniform code of plumbing laws for the entire State.

Appropriations and Expenditures.

Regular Appropriations.

Division of Administration.

Appropriation,	$28,000 00
Credit by transfer from venereal diseases,	570 00
Credit by rebate on mileage returned,	43 97
Credit by cash returned to treasury,	8 81
	$28,622 78
Salaries,	$18,636 47
Traveling,	757 13
Express,	177 79
Printing and binding,	4,267 33 [1]
Books and subscriptions,	215 45
Advertising,	17 38
Stationery, maps and blue-prints,	471 82
Postage and postal orders,	2,145 42
Telephone and telegraph messages,	354 48
Typewriting supplies and repairs,	135 21
Sundry office supplies,	91 86
Extra services,	1 00
Messenger,	212 88
Miscellaneous,	91 04
Total,	$27,575 26
Unexpended balance,	1,047 52
	$28,622 78

[1] Includes annual report.

Division of Hygiene.

Appropriation for the year ended Nov. 30, 1918,	$24,500 00
Credit by rebate on mileage returned,	48 03
	$24,548 03
Salaries,	$10,738 22
Traveling,	4,422 58
Express,	145 46
Printing and binding,	5,222 54
Books and subscriptions,	60 80
Advertising and educational work,	1,249 46
Stationery, maps and blue-prints,	141 86
Postage,	704 22
Telephone and telegraph,	148 46
Typewriting supplies and repairs,	246 99
Extra services,	202 05
Laboratory supplies,	28 94
Miscellaneous,	98 16
Total,	$23,409 74
Unexpended balance,	1,138 29
	$24,548 03

Expenses under the Provisions of the Act to provide for the Establishment of Health Districts and the Appointment of State Inspectors of Health (Chapter 537, Acts of 1907, Chapters 405 and 543, Acts of 1910, Chapters 603 and 609, Acts of 1911) for the Year ended Nov. 30, 1918.

Appropriations,	$65,850 00
Credit by cash returned to treasury from various sources,	266 33
Credit by salaries transferred to appropriation for venereal diseases,	824 97
	$66,941 30
Salaries,	$45,259 46
Traveling,	8,345 11
Express,	33 69
Printing,	726 15
Books and maps,	81 49
Postage,	1,634 67
Typewriting supplies and rental,	151 37
Extra services,	1,199 21
Telephone and telegraph,	464 11
Office supplies and stationery,	470 55
Laboratory and experimental work,	20 00
Laboratory supplies,	593 05
Mailing cases,	283 46

Purchase of animals,	$189 60
Food for animals,	19 23
Labor,	892 75
Miscellaneous,	50 56
Total,	$60,414 46
Unexpended balance,	6,526 84
	$66,941 30

Expenditures for the Production and Distribution of Antitoxin and Vaccine for the Year ended Nov. 30, 1918.

Appropriation,	$40,000 00
Credit by amount paid out on account of United States Venereal Trust,	519 77
Credit by refund to treasury on account of freight,	3 50
	$40,523 27
Salaries,	$18,515 90
Apparatus, chemicals and laboratory supplies,	5,813 79
Traveling,	204 79
Express,	115 91
Typewriting supplies, books and stationery,	148 48
Printing,	731 85
Purchase of animals,	2,677 80
Shipping,	1,486 26
Services of veterinary surgeon and saddlery,	27 75
Food for animals,	4,514 60
Rental of telephone, messages and postage,	456 06
Extra services,	252 88
Water, gas, electric lighting and heating,	1,299 57
Labor and materials,	1,646 67
Ice,	417 95
Rent,	2,058 32
Miscellaneous,	438 87
Total,	$40,807 45

Expenditures under the Provisions of the Food and Drug Acts for the Year ended Nov. 30, 1918.

Appropriation,	$33,000 00
Credit by rebate on mileage returned,	85 30
Credit by transfer from United States Venereal Trust,	60 56
	$33,145 86

Salaries,	$26,739 75
Apparatus and chemicals,	737 85
Traveling,	3,093 37
Purchase of samples,	635 20
Express,	75 91
Printing,	281 69
Books, maps and stationery,	164 11
Telephone, telegraph messages and postage,	417 69
Sundry laboratory supplies,	190 99
Typewriting supplies and repairs,	79 52
Services, cleaning laboratory,	121 00
Advertising,	11 95
Branding outfits,	37 71
Miscellaneous,	7 65
Total,	$32,594 39
Unexpended balance,	551 47
	$33,145 86

For carrying out the Provisions of the Act to protect the Purity of Inland Waters, for the Examination of Sewer Outlets, and for the Examination of the Sanitary Condition of Certain Rivers and Watercourses.

Appropriation for the year ended Nov. 30, 1918,	$56,800 00
Credit by cash returned to treasury from different sources,	403 57
Credit by transfer from appropriation for domestic water supplies,	492 80
	$57,696 37
Salaries,	$45,074 18
Apparatus and materials,	2,389 87
Traveling,	4,708 47
Express,	1,071 10
Maps, blue-prints and books,	288 13
Printing and binding,	304 87
Stationery, drawing materials and typewriting supplies,	315 20
Telephone and telegraph messages and postage,	410 13
Services, collecting samples and reading gauges,	386 67
Labor,	76 96
Rent,	150 00
Miscellaneous,	124 05
Total,	$55,299 63
Unexpended balance,	2,396 74
	$57,696 37

State Examiners of Plumbers.

Appropriation for the year ended Nov. 30, 1918,	$4,800 00
Salary of secretary,	$2,000 00
Examiners' wages,	565 00
Traveling,	551 06
Express,	29 14
Printing,	158 32
Postage,	195 02
Books, stationery and typewriting supplies,	18 31
Plumbers' materials,	4 00
Extra services,	940 00
Cleaning,	25 80
Office supplies,	1 00
Telephone and lighting,	91 44
Miscellaneous,	6 75
Total,	$4,585 84
Unexpended balance,	214 16
	$4,800 00

For carrying out the Provisions of the Act relative to the Prevention of Ophthalmia Neonatorum (Chapter 458, Acts of 1910).

Appropriation for the year ended Nov. 30, 1918,	$1,000 00
Printing,	$5 39
Ophthalmia outfits,	970 24
Total,	$975 63
Unexpended balance,	24 37
	$1,000 00

SPECIAL APPROPRIATIONS.

Expenditures under the Provisions of the Act for the Prevention and Suppression of Syphilis (Chapter 47, Resolves of 1916) for the Year ended Nov. 30, 1918.

Appropriation,	$10,000 00
Expended in 1916 and 1917,	4,931 98
Balance,	$5,068 02
Salaries,	$1,041 67
Apparatus and laboratory supplies,	1,783 58

Chemicals,	$1,422 80
Testing,	187 50
Animals,	9 90
Packing,	420 73
Printing,	81 09
Travel,	53 80
Miscellaneous,	66 90
Total,	$5,067 97

Expenditures from June 1 to Nov. 30, 1918, for the Prevention of Venereal Diseases.

Appropriation,	$30,000 00
Salaries,	$4,927 97
Traveling,	174 70
Postage,	990 00
Telephone and telegraph,	3 09
Books and stationery,	148 70
Printing,	1,805 11
Laboratory supplies,	1,306 85
Office supplies,	7 95
Typewriting supplies,	125 10
Clinics,	7,000 00
Educational,	2,793 39
Labor and materials,	141 03
Animals,	68 00
Miscellaneous,	18 10
Total,	$19,509 99
Unexpended balance,	10,490 01
	$30,000 00

Expenditures under the Provisions of Chapter 58, Resolves of 1918, for Report of a Plan for the Disposal of Sewage in the Town of Ayer.

Appropriation,	$800 00
Salaries,	$435 97
Traveling,	298 59
Express,	84
Maps and blue prints,	8 12
Drawing materials and office supplies,	4 35
Total,	$747 87
Unexpended balance,	52 13
	$800 00

Expenditures under the Provisions of Chapter 24, Resolves of 1918, for the Investigation of Hale's Brook.

Appropriation,	$1,000 00
Salaries,	$773 15
Traveling,	96 64
Express,	1 34
Maps and blue prints,	10 83
Drawing materials,	11 50
Special investigation,	30 00
Total,	$923 46
Unexpended balance,	76 54
	$1,000 00

RECAPITULATION.

Regular Appropriations.

	Appropriation.	Expended.
For the Division of Administration,	$28,000 00	$26,922 31
For the Division of Hygiene,	24,500 00	23,361 71
For the Division of Communicable Diseases,	65,850 00	59,323 16
For the prevention of ophthalmia neonatorum,	1,000 00	975 63
For the Division of Food and Drugs,	33,000 00	32,428 46
For the production and distribution of antitoxin and vaccine,	40,000 00	40,284 18
For water supply and sewage disposal,	56,800 00	54,403 26
For the State Examiners of Plumbers,	4,800 00	4,585 84
Totals,	$253,950 00	$242,284 55

Special Appropriations.

For the prevention and suppression of syphilis, balance from 1917,	$5,068 02	$5,067 97
For the prevention and suppression of venereal diseases,	30,000 00	19,509 99[1]
For report of a plan for the disposal of sewage in the town of Ayer,	800 00	747 87
For the investigation of Hale's Brook,	1,000 00	923 46
Totals,	$36,868 02	$26,249 29

[1] June 1 to November 30.

EUGENE R. KELLEY,
Commissioner of Health.

SUPPLEMENT.

DIVISION OF SANITARY ENGINEERING.

X. H. GOODNOUGH, *Director*.

REPORT OF DIVISION OF SANITARY ENGINEERING.

During the past year the work of the Division has been greatly hampered by the fact that nearly all of its engineering force entered the military service of the United States, a total of nineteen in all having entered the service directly from this Division, leaving but three engineers formerly connected with the Department to carry on its work. It has been practicable, however, to secure the assistance of one or two experienced engineers not within the draft age to aid in carrying out the work of the Division in the oversight and care of inland waters, and advising cities, towns and others relative to water supplies, drainage, sewerage and matters relating thereto.

The applications for advice received by the Department for the approval of plans for water and sewerage works during the past year have numbered 147, the same as in the previous year. Of these applications, 40 were in relation to public water supplies, 60 to private water supplies, 3 to sources of ice supply, 22 to drainage, sewerage and sewage disposal, 7 to pollution of streams and 15 to miscellaneous matters.

Very little work has been undertaken by cities and towns during the year in the introduction and extension of water supplies and sewerage systems, and that only in cases of emergency; but an unusual number of applications has been received relative to the water supply and sanitation of military and other camps.

General Water Supply Situation and Necessity for Present Action for the Protection and Development of Available Additional Sources.

Some twenty-five years have elapsed since the investigations with reference to a metropolitan water supply were begun by this Department under direction of the Legislature, and the works then recommended and subsequently constructed have now been in use for many years. They were designed on broad lines suited to meet the needs of the metropolitan district as then created, and capable of a gradual development to serve the areas for which they were intended to provide for a very long time in the future. These works are serving their purpose admirably, are providing a most excellent water supply in ample

quantity at a very reasonable cost, and are capable of great extension to meet future needs at a moderate outlay as compared with the cost of the original works, thus insuring to this district, if future management shall be like the past, an ample supply of excellent water at a gradually diminishing cost.

In the years that have elapsed since the metropolitan district was established, other municipalities, both in its immediate neighborhood and elsewhere, have reached the point where their local water supplies are either unsatisfactory or unsuited to much further development than that which will meet the needs of the immediate future, and the question of providing water in many of these areas is rapidly becoming a serious one. In certain of these districts there are sources which appear capable of development into excellent water supplies at moderate expense, if set apart for such use in reasonable season, but which may become objectionable on account of cost or for other reasons if their acquisition is too long delayed.

Prominent among these districts is a large area in southeastern Massachusetts, comprised chiefly within the watershed of the Taunton River and certain small watersheds adjacent thereto, draining southerly into the sea and containing the cities of New Bedford, Fall River and Taunton, to which attention has already been called in a previous report. Throughout the greater part of this region the conditions for obtaining municipal water supplies of large capacity with reasonable economy are quite unfavorable. The streams for the most part flow through wide, flat valleys, occupied largely by swamps, and the contour of the ground is unfavorable for the construction of reservoirs of large capacity suitable for the storage of water for municipal uses; but this area contains two groups of remarkable natural storage reservoirs, one, the Lakeville ponds, so called, in the watershed of the Nemasket River, covering an area of 5,867 acres, and the other, the Watuppa ponds, in the city of Fall River, covering an area of 4,337 acres. From the former group of lakes the cities of New Bedford and Taunton obtain their water supplies at the present time, while the northerly part of the latter group supplies the city of Fall River. For the protection of their water supplies these cities have from time to time acquired lands about their sources which now amount in the aggregate to a very large area, but, while some of the sources are well protected in this way, others remain open to settlement, and, unless the control of these sources is secured in the immediate future, it may become impracticable to protect them thoroughly at reasonable cost. Under these conditions, the municipalities in this region, or some of them, may be forced to use polluted or inferior waters, depending for the improvement of such waters and the protection of the public health upon filtration or

such other treatment as may be found necessary; or it may be necessary to supply water in these regions from other sections of the State. It seems most important to determine in the immediate future upon some plan to be followed in developing water supply in this region, whether by securing control of these lakes or otherwise, and to determine, also, whether it may be practicable to allow the use of these great ponds or a part of them, for a time at least, by the public for boating and fishing.

In the extreme northeastern section of the State the populous valley of the Merrimack River presents already a number of serious water supply problems. Included in this valley are the cities of Lowell, Lawrence, Methuen, Haverhill and Newburyport and a number of populous towns, the aggregate population of the municipalities in the valley which border the river or are situated in its neighborhood amounting by the census of 1915 to 329,536. With the exception of Groveland, which is supplied with water from the Haverhill system, all of these cities and towns maintain independent water supplies from local sources. The city of Lawrence obtains its water supply from the Merrimack River after filtration, but the supply is considered objectionable from several points of view, and the city has under consideration a plan for developing a new water supply from sources independent of the river, which would require a very large outlay. The city of Lowell has supplied itself for many years with ground waters obtained in two widely separated areas, one located on the northerly side of the Merrimack River west of the city, and the other in the valley of River Meadow Brook. The ground water obtained near the Merrimack River is objectionable on account of the presence of an excess of iron and manganese, and extensive works have recently been constructed for the treatment and purification of the water from this source. The water obtained from the valley of River Meadow Brook south of the city contains an excessive quantity of carbonic acid, and acts strongly upon the lead service pipes through which it is delivered to consumers. A serious epidemic of lead poisoning resulted from the use of this water several years ago, and the city has been warned to discontinue its use, unless the water is so treated as to remove the substances which act most seriously upon lead pipes. The city has found it impracticable in recent years to provide sufficient water without using this supply, but treatment works have not yet been provided. The water supply of Methuen is inadequate and unsatisfactory, nor does there appear to be a suitable source available for this city, unless in conjunction with one of its neighbors. The quality of the water supplied in Amesbury is objectionable, while the water supplies of some of the other municipalities are apparently incapable of further economic

development. The question of additional grants of water supply sources in this region will undoubtedly soon come up, and the best interests of all require a thorough study of the water supply needs of the whole valley before special rights are granted in any of the limited number of sources that remain available for water supply uses in this region.

Another district in which the water supply situation has again become serious is in the southern part of Essex County and the region of the Ipswich River valley. Legislative rights to water supply from the Ipswich River or its tributaries have already been granted to the cities and towns of Reading, Lynn including Saugus, Peabody, Danvers including Middleton, Salem and Beverly, and rights in this river will doubtless eventually be required by other towns in this region. The rights already granted in this river are limited, and a demand for their extension is inevitable. In this case the Department has already been authorized to study the problem of the use of the surplus summer flow of this river, and a small appropriation was made therefor at the last session of the Legislature; but the larger question of storage is also involved, and a further study of the whole question of water supply development in the territory depending upon this river should be made at the earliest practicable time if it is to be completed in season to meet the growing demand for an increased water supply in this district.

While the water supply problem is most serious in the districts already mentioned, similar questions have arisen or are likely soon to arise in other areas, which will involve a thorough investigation for their proper solution. South of the metropolitan district and along its borders are several towns in which the water supplies are of limited capacity, while in some of them an additional water supply is an immediate need. This group includes the towns of Norwood, Canton, Braintree, Weymouth, Hingham, Hull, Cohasset and Scituate, with possibly others in the neighborhood. Some of these towns are included within the limit of ten miles from the State House, within which the metropolitan water district can supply water without additional legislation; but to extend the metropolitan water supply piecemeal to these districts will involve a much greater expense than would be the case if several of them could be supplied together, and it is important to determine whether it is best for all of them to develop local sources further, either individually or in groups, or whether any or all of them can be supplied more economically and acceptably to all concerned from the metropolitan district. In this region, also, the sources available for further development are limited, and many of the waters are unsatisfactory for the purposes of municipal water supply.

One of the chief sources of water supply in the southwesterly section

of the metropolitan area is the Charles River valley, from the lower portion of which the cities of Cambridge, Waltham and Newton, and the towns of Weston, Wellesley, Brookline, Needham and Dedham, obtain their water supplies at the present time. In the case of Cambridge the supply is obtained from storage reservoirs on the tributary stream known as Stony Brook, while all the others obtain their water supplies by means of wells sunk in the extensive gravel beds which border this river throughout the greater part of this region. The Cambridge supply is capable of further development, but the maximum development of which it is capable will not enable it to furnish more than about 14,400,000 gallons per day, a quantity of water only 29 per cent in excess of the amount used by the city in the twelve months which ended with November, 1918. Even this development will involve a very considerable outlay. The city of Waltham has practically reached the limit of the supply of good water obtainable in the areas available to that city along Charles River. The city of Newton is already a part of the metropolitan water supply district and can use metropolitan water whenever such necessity may arise. It has thus far obtained its supply from the gravel beds available to the city in Needham. The town of Brookline obtains its water from the region above that used by the city of Newton, but the water is affected by mineral matter, and a treatment works has recently been established to improve its quality. The Dedham Water Company supplies the town of Dedham with water taken still farther upstream than the region in which the Brookline works are situated. The water supplies of Wellesley and Needham are obtained from the valleys of tributary streams in the immediate neighborhood of the main river, while that of Weston is obtained from the valley of Stony Brook. The region from which these water supplies are obtained borders the metropolitan district, and the population is increasing quite rapidly in the neighborhood of many of the areas from which these water supplies are drawn. It is obvious that there will be increasing difficulty in the future in securing in these areas waters of satisfactory purity, while the supply is so limited in some cases that additional sources will soon become necessary.

North of the metropolitan water district and adjacent to it are Winchester, Wakefield and Woburn, each of which is at present provided with an independent water supply. That of Winchester is of satisfactory quality, and the quantity is likely to be sufficient until the population of the town becomes considerably larger than it is at the present time. In Woburn, also, the water supply is adequate for present needs, though its quality is affected somewhat by the population in the neighborhood of the sources of supply. In Wakefield the

water supply is obtained from a lake adjacent to the thickly populated portion of the town, and the water in its present condition is unsafe for domestic use.

There are also other regions in which the question of water supply requires careful study, especially in some of the cities and towns in the region from which the metropolitan water supply is obtained. Part of the water supply of the city of Worcester is obtained from a watershed used by the metropolitan water district, and that city is now making investigations with reference to securing an additional supply, of which it stands greatly in need. The question as to whether that city can best be supplied from the areas from which the metropolitan district now takes its supply, or in connection with the metropolitan system, or from other sources, will soon come up for consideration, and if the metropolitan sources appear to be the best available, it is not improbable that, with the addition of this large city to the draft upon the system, coupled with the possible requirements of other areas, the further extension of the metropolitan supply may soon become necessary.

In view of the conditions in many of the districts of the State as indicated in the outline herein, it is important that a thorough study be made of the whole problem of water supply in all portions of the State, but especially in the areas herein described, in order that an ample supply of good water may be made available for the use of the inhabitants at all times and the danger of shortage of water supply or of injury to the public health from the use of inferior water supplies may be avoided. These questions are of the utmost importance. A public water supply under modern conditions is by far the most important of all public services. Upon it depends the means for extinguishing fires, all too common under our New England conditions of building. No article of diet is as essential to the health of the individual as pure water, and none is capable of causing more widespread and serious injury to the public health than drinking water containing injurious substances. A pure water is also most valuable for mechanical uses and for many manufacturing purposes, and the possession of an excellent water supply is a most important asset to any municipality. The standing of Massachusetts water supplies has thus far been high, and it is important that this standard be maintained. With the rapid growth of population in the metropolitan district and in other great industrial areas in the State the enlargement of local water supplies is constantly necessary, and the available drainage areas suited to the purpose of providing public water supplies are becoming measurably restricted.

There will undoubtedly arise in the near future serious questions as

to grants of new sources of water supply in many parts of the State, and the interests of all concerned require that the selection and development of new sources shall be made in the light of full information as to circumstances affecting the sources which are found to be available and their appropriateness for the purpose for which their use is proposed. A thorough study of the whole problem would furnish the information necessary for the selection of the most appropriate sources of water supply for the various municipalities, with due regard for the needs and interests of the other cities, towns and persons which may be affected thereby. Much information of value in connection with such an investigation, including records of rainfall, flow of streams, yield of watersheds, the character of their waters and means for their protection, has been accumulated by this Division in connection with its general oversight of inland waters under existing laws, and much additional information as to water supply in a large part of the State has been gathered by the Metropolitan Water and Sewerage Board in an experience of many years in the construction, maintenance and operation of the metropolitan water works. It would undoubtedly be advantageous to combine the two departments in such an investigation as is here proposed, thus making the experienced engineering staffs of these departments available for the general direction of the work, and it is probable that, notwithstanding the far greater number of sources requiring careful consideration and the greater cost of such work at the present time, an appropriation no greater than that which was necessary in connection with the original metropolitan water supply investigation will be sufficient for the work. An appropriation of $50,000 would probably be required for carrying out the work herein proposed, which can probably be completed within two years.

Water Supply of the City of Lawrence.

In the severe winter of 1917–18, the filters of the city of Lawrence, when operated to their full capacity and supplemented as fully as possible with auxiliary supplies from Andover and North Andover, were inadequate for the filtration of all of the water required for the supply of the city, and toward the end of the winter the distributing reservoir which holds 40,000,000 gallons became nearly exhausted. It being obvious from this experience that with the increasing consumption of water it would be impracticable for the city to obtain a sufficient supply during another winter without increasing the capacity of the filters, the Department took up the matter with the Lawrence authorities at a conference on August 21, and on August 23 sent a communication to the city urging the immediate covering of the easterly section

of the old filter already partially rebuilt, and urging also that the remainder of the old filter be covered as soon as practicable in the coming season. The city after some delay undertook the work and completed the covering of about one-third of the old filter before the beginning of cold weather. With this additional filter capacity, it is probable that an adequate supply of water can be obtained by the city during the coming winter.

It has been recommended to the city government that it make still further provision for the enlargement of its filtration works early in 1919, so as to provide an ample supply of water for the next few years and discontinue the purchase of water from Andover and North Andover.

Further Water Supply from the Ipswich River.

Under the provisions of chapter 73 of the Resolves of the year 1917, the State Department of Health is authorized to investigate and report upon the advisability of granting to the cities and towns now having authority to take water from the Ipswich River for municipal uses the additional authority to use the surplus flow of said river during the months from June to November, inclusive, for water supply purposes. A report under this resolve was required to be presented to the Legislature of 1918, but the sum appropriated for the purpose having been found to be inadequate, the time within which the report should be made was extended to the second Wednesday in January in the year 1919, and an additional appropriation was made for the purpose.

Sanitary Protection of Public Water Supplies.

The usual number of cases have arisen during the year in which the advice of the Department has been sought relative to the protection of the purity of public water supplies.

Additional rules and regulations were established for the protection of the water supply of Holyoke, and rules were also made for the protection of the new water supply of Fitchburg taken from Ashby Reservoir. Amendments were made to the rules at Haverhill and Greenfield.

Early in the year a decision was handed down by the Supreme Court in a case relating to fishing in a public water supply in violation of the rules and regulations of the State Department of Health, which has an important bearing upon the protection of public water supplies. The decision is as follows: —

WATER SUPPLY — PROHIBITION OF FISHING BY MUNICIPALITIES WITHIN POLICE POWER IN ORDER TO MAINTAIN PURITY OF WATER.

RUGG, C.J. This is a complaint charging the defendant with going upon the ice of Crystal Lake and fishing therein without a written permit of the water commissioners of the city of Haverhill, in violation of rules and regulations of the State Board of Health. The pertinent part of the regulation of the State Board of Health is as follows: —

> No person shall. . . . unless permitted by a written permit of the board of water commissioners of the city of Haverhill, fish in . . . Crystal Lake. . . . so called, in the city of Haverhill. . . . said lakes . . . being used by said city as sources of water supply.

The regulation was passed pursuant to R. L., c. 75, § 113, as amended by St. 1907, c. 467, § 1, which empowers the State Board of Health to "make rules and regulations to prevent the pollution and to secure the sanitary protection, of all such waters as are used as sources of water supply," with power to delegate the granting or withholding of permits to water commissioners, subject to investigation and revision by way of appeal to the Board itself.

The delegation by the Legislature of the right to make rules and regulations is within its power. Commonwealth *v.* Sisson, 189 Mass. 247; Commonwealth *v.* Kingsbury, 199 Mass. 542. The case at bar thus is distinguished from Commonwealth *v.* Staples, 191 Mass. 384, where no power of delegation was conferred by the statute there under consideration. The power of revising the conduct of the water commissioners reserved to the State Board of Health by the statute avoids the difficulty of vesting an untrammelled discretion in a subordinate board or officer, which was held fatal to the ordinance before the court in Commonwealth *v.* Maletsky, 203 Mass. 241. Goldstein *v.* Connor, 212 Mass. 57; Stevens, Landowner, 228 Mass. 368. The regulation passed by the State Board of Health, in pursuance of the statutory authority, prohibiting fishing upon a body of water used as source of water supply for a municipality, cannot be pronounced unreasonable. It requires no discussion to demonstrate that the preservation of the purity of the water supply for the domestic uses of the people is within the police power. The absolute prohibition of fishing upon such a source of supply could not be said to be unreasonable under the circumstances here disclosed. It is not irrational for a public board to deem it likely or possible that sources of contamination and germs of disease might have a causal connection with the presence of fishermen upon the ice or waters of a supply of drinking water. Nelson *v.* State Board of Health, 186 Mass. 330; Sprague *v.* Minor, 195 Mass. 581. The case of Austin *v.* Murray, 16 Pick. 121, upon which the defendant relies, is quite distinguishable.

Exceptions overruled.

FEB. 9, 1918.

Examination of Domestic Water Supplies.

Under the provisions of chapter 90 of the Resolves of the year 1917, the State Department of Health is authorized to make sanitary examinations of water supplies used for domestic purposes and obtained from other sources than the public water supply systems, including chemical and bacterial analyses of the water when necessary. The Department is also required to advise as to the location of new domestic water supplies and the protection of such supplies in a manner similar to that now required with reference to public water supplies.

Under this resolve thirty-five sources of water supply were examined during the year, many of which were found so badly polluted as to be unfit for use. This work is a valuable one for the protection of health, especially in thickly settled communities where there is no public water supply, and it is recommended that the work be continued.

Analyses of the Water of Public Water Supplies.

Averages of Chemical Analyses of Surface-water Sources for the Year 1918.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.			Chlorine.	Hardness.
				Free.	Albuminoid.			
					Total.	Suspended.		
Metropolitan Water District.	Wachusett Reservoir, upper end,	.26	4.17	.0027	.0149	.0023	.32	1.3
	Wachusett Reservoir, lower end,	.14	3.21	.0024	.0121	.0014	.29	1.1
	Sudbury Reservoir,	.17	3.70	.0033	.0146	.0025	.32	1.3
	Framingham Reservoir No. 3,	.18	3.84	.0030	.0164	.0032	.32	1.4
	Hopkinton Reservoir,	.54	4.09	.0037	.0217	.0034	.37	1.3
	Ashland Reservoir,	.61	4.32	.0035	.0243	.0030	.37	1.4
	Framingham Reservoir No. 2,	.69	5.13	.0050	.0266	.0035	.44	1.6
	Lake Cochituate,	.19	6.41	.0029	.0262	.0070	.73	2.5
	Chestnut Hill Reservoir,	.18	3.68	.0022	.0144	.0022	.33	1.4
	Weston Reservoir,	.17	3.52	.0027	.0167	.0037	.33	1.4
	Spot Pond,	.12	3.66	.0018	.0169	.0032	.35	1.4
	Tap in State House,	.18	3.88	.0018	.0155	.0028	.33	1.5
	Tap in Revere,	.10	3.81	.0016	.0139	.0019	.33	1.5
	Tap in Quincy,	.16	3.72	.0013	.0118	.0011	.33	1.4
Abington,	Big Sandy Pond,	.12	3.68	.0034	.0144	.0013	.79	1.1
Adams,	Dry Brook,	.25	8.14	.0050	.0143	.0024	.15	5.1
	Bassett Brook,	.05	4.34	.0020	.0071	.0011	.13	2.5

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.			Chlorine.	Hardness.
				Free.	Albuminoid.			
					Total.	Suspended.		
Amherst,	Amethyst Brook large reservoir,	.46	3.95	.0035	.0179	.0034	.20	1.0
	Amethyst Brook small reservoir,	.19	3.39	.0066	.0163	.0041	.21	0.8
Andover,	Haggett's Pond,	.15	4.18	.0028	.0187	.0038	.40	1.6
Ashburnham,	Upper Naukeag Lake,	.06	2.39	.0018	.0116	.0011	.16	0.7
Ashfield,	Bear Swamp Brook,	.29	5.83	.0043	.0123	.0006	.18	2.9
Athol,	Phillipston Reservoir,	.39	3.97	.0035	.0261	.0082	.19	1.2
	Buckman Brook Reservoir,	.22	3.88	.0078	.0206	.0031	.17	1.0
	Inlet of Filter,	.86	4.77	.0095	.0302	.0062	.18	1.2
	Outlet of Filter,	.75	4.74	.0075	.0243	–	.18	1.4
Barre,	Reservoir,	.17	4.62	.0056	.0171	.0035	.29	1.8
Blandford,	Freeland Brook,	.06	3.67	.0008	.0051	.0003	.23	1.7
Brockton,	Silver Lake,	.10	3.54	.0026	.0138	.0033	.66	0.8
Cambridge,	Lower Hobbs Brook Reservoir,	.15	6.64	.0061	.0235	.0038	.50	2.4
	Stony Brook Reservoir,	.38	6.89	.0053	.0245	.0040	.59	2.4
	Fresh Pond,	.22	6.96	.0098	.0263	.0066	.64	2.7
Cheshire,	Thunder Brook,	.04	10.35	.0013	.0045	.0003	.12	8.7
	Kitchen Brook,	.01	7.65	.0008	.0039	.0002	.08	6.2
Chester,	Austin Brook Reservoir,	.13	4.60	.0054	.0266	.0092	.13	2.0
Chicopee,	Morton Brook,	.08	3.96	.0008	.0051	.0007	.16	1.3
	Cooley Brook,	.28	4.32	.0055	.0114	.0039	.15	1.3
Colrain,	McClellan Reservoir,	.03	7.05	.0042	.0100	.0008	.09	4.3
Concord,	Nagog Pond,	.03	2.71	.0019	.0147	.0018	.40	0.9
Dalton,	Egypt Brook Reservoir,	.20	2.80	.0031	.0115	.0013	.09	1.2
	Cady Brook,	.21	4.38	.0013	.0101	.0008	.10	2.3
Danvers,	Middleton Pond,	.47	4.56	.0023	.0240	.0030	.43	1.7
Deerfield (South),	Roaring Brook,	.14	7.60	.0013	.0042	.0002	.22	4.1
Egremont (South),	Goodale Brook,	.02	4.67	.0005	.0041	.0003	.13	2.5
Fall River,	North Watuppa Lake,	.14	4.05	.0030	.0192	.0030	.62	1.0
Falmouth,	Long Pond,	.62	3.73	.0018	.0117	.0015	1.05	0.4
Fitchburg,	Meetinghouse Pond,	.06	3.32	.0059	.0161	.0026	.19	1.0
	Scott Reservoir,	.12	3.14	.0063	.0148	.0032	.22	0.9
	Wachusett Lake,	.11	2.81	.0049	.0138	.0015	.20	1.0
	Falulah Brook,	.24	3.31	.0066	.0229	.0045	.22	0.8
Gardner,	Crystal Lake,	.10	5.12	.0025	.0143	.0031	.32	2.1

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.			Chlorine.	Hardness.
				Free.	Albuminoid.			
					Total.	Suspended.		
Gloucester,	Dike's Brook Reservoir,	.35	3.72	.0055	.0171	.0021	.81	0.6
	Wallace Reservoir,	.59	4.81	.0045	.0252	.0068	.95	0.5
	Haskell Brook Reservoir,	.24	3.88	.0020	.0147	.0035	.82	0.5
Great Barrington,	East Mountain Reservoir,	.13	5.82	.0026	.0109	.0018	.12	4.1
	Green River,	.09	10.84	.0007	.0043	.0005	.14	9.1
Great Barrington (Housatonic).	Long Pond,	.10	9.95	.0056	.0222	.0023	.16	6.9
Greenfield,	Glen Brook Lower Reservoir,	.01	5.53	.0032	.0067	.0011	.15	3.0
Hatfield,	Running Gutter Brook Reservoir,	.08	5.65	.0014	.0058	.0007	.23	2.5
Haverhill,	Johnson's Pond,	.17	4.94	.0019	.0184	.0013	.51	2.4
	Crystal Lake,	.19	4.87	.0044	.0278	.0080	.43	1.8
	Kenoza Lake,	.21	5.54	.0025	.0244	.0045	.46	2.4
	Lake Saltonstall,	.16	6.56	.0074	.0213	.0042	.65	2.9
	Lake Pentucket,	.16	5.38	.0038	.0251	.0060	.58	2.3
	Millvale Reservoir,	.48	6.23	.0034	.0251	.0053	.41	2.3
Hingham,	Accord Pond,	.22	3.42	.0025	.0169	.0016	.60	0.5
Hinsdale,	Reservoir,	.19	2.32	.0021	.0144	–	.13	0.7
Holyoke,	Whiting Street Reservoir,	.09	4.84	.0056	.0154	.0030	.23	2.6
	Fomer Reservoir,	.35	4.21	.0043	.0147	.0030	.17	1.5
	Wright and Ashley Pond,	.15	4.98	.0067	.0180	.0026	.19	2.6
	High Service Reservoir,	.15	3.95	.0064	.0169	.0023	.20	1.6
	White Reservoir,	.26	3.76	.0069	.0213	.0049	.16	1.6
Hudson,	Gates Pond,	.08	3.35	.0033	.0158	.0018	.28	1.6
Ipswich,	Dow's Brook Reservoir,	.29	5.77	.0033	.0219	.0025	.76	1.9
Lawrence,	Merrimack River, filtered,	.34	6.24	.0071	.0095	–	.50	1.3
Lee,	Codding Brook Upper Reservoir,	.11	5.70	.0085	.0117	.0025	.14	2.1
	Codding Brook Lower Reservoir,	.13	4.52	.0013	.0099	.0013	.13	3.1
	Basin Pond Brook,	.58	5.00	.0018	.0180	.0022	.10	1.5
Lenox,	Reservoir,	.08	7.32	.0017	.0078	.0014	.14	5.5
Leominster,	Morse Reservoir,	.22	3.13	.0069	.0226	.0039	.22	0.5
	Haynes Reservoir,	.38	3.27	.0250	.0380	.0122	.21	0.6
	Fall Brook Reservoir,	.13	2.69	.0029	.0147	.0017	.21	0.7
Lincoln,	Sandy Pond,	.12	3.38	.0090	.0204	.0055	.42	1.3
Longmeadow,	Cooley Brook,	.13	5.64	.0026	.0096	.0023	.27	2.6
Lynn,	Birch Reservoir,	.22	4.65	.0094	.0207	.0027	.69	1.7

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.			Chlorine.	Hardness.
				Free.	Albuminoid.			
					Total.	Suspended.		
Lynn — *Con.*,	Breed's Reservoir,	.41	5.24	.0152	.0317	.0057	.69	2.0
	Walden Reservoir,	.53	6.08	.0066	.0255	.0041	.77	2.1
	Hawkes Reservoir,	.63	7.15	.0102	.0338	.0060	.90	2.8
Manchester,	Gravel Pond,	.11	4.42	.0134	.0139	.0027	.86	1.2
Marlborough,	Lake Williams,	.14	4.95	.0026	.0211	.0025	.60	1.9
	Millham Brook Reservoir,	.43	5,16	.0055	.0239	.0041	.46	1.6
Maynard,	White Pond,	.42	3.87	.0012	.0140	.0017	.32	1.1
Milford,	Charles River, filtered,	.20	6.37	.0011	.0069	-	.37	2.7
Montague,	Lake Pleasant,	.06	2.53	.0019	.0099	.0014	.18	0.8
Nantucket,	Wannacomet Pond,	.12	7.17	.0013	.0194	.0061	2.30	1.5
New Bedford,	Little Quittacas Pond,	.33	3.59	.0033	.0212	.0023	.58	1.0
	Great Quittacas Pond,	.42	4.04	.0023	.0205	.0026	.59	1.0
North Adams,	Notch Brook Reservoir,	.06	8.05	.0024	.0072	.0016	.10	6.2
	Beaman Reservoir,	.06	7.59	.0044	.0100	.0016	.09	4.5
Northampton,	Middle Reservoir,	.22	4.51	.0026	.0137	.0024	.18	1.8
	Mountain Street Reservoir,	.09	4.32	.0019	.0100	.0021	.12	2.0
North Andover,	Great Pond,	.14	4.64	.0032	.0219	.0032	.50	2.0
Northborough,	Lower Reservoir,	.85	5.02	.0082	.0311	.0087	.37	1.5
Northbridge,	Cook Allen Reservoir,	.00	2.98	.0007	.0042	.0006	.22	0.8
North Brookfield,	Doane Pond,	.42	3.73	.0059	.0382	.0122	.20	1.1
	North Pond,	.48	3.53	.0051	.0522	.0225	.22	0.9
Northfield,	Reservoir,	.18	3.73	.0009	.0073	.0003	.15	1.4
Orange,	Reservoir,	.12	3.48	.0024	.0080	.0005	.12	1.2
Palmer,	Lower Reservoir,	.18	4.09	.0061	.0153	.0050	.18	1.2
Peabody,	Spring Pond,	.32	6.97	.0108	.0246	.0069	.87	2.6
	Suntaug Lake,	.06	5.87	.0070	.0220	.0046	1.23	2.8
Pittsfield,	Ashley Brook,	.18	5.85	.0054	.0173	.0024	.12	3.9
	Hathaway Brook,	.05	9.55	.0024	.0089	.0013	.14	6.9
	Mill Brook,	.48	5.23	.0026	.0202	.0032	.14	2.4
	Sacket Brook,	.08	7.64	.0024	.0080	.0011	.14	5.8
	Farnham Reservoir,	.52	5.02	.0040	.0223	.0027	.14	1.9
Plymouth,	Little South Pond,	.05	3.21	.0017	.0192	.0031	.69	0.3
	Great South Pond,	.04	3.23	.0034	.0193	.0023	.69	0.3
Randolph,	Great Pond,	.41	4.42	.0025	.0159	.0030	.59	0.8

Averages of Chemical Analyses of Surface-water Sources, etc. — Concluded.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.			Chlorine.	Hardness.
				Free.	Albuminoid. Total.	Albuminoid. Suspended.		
Rockport,	Cape Pond,	.54	11.55	.0147	.0407	.0135	4.15	2.2
Russell,	Black Brook,	.18	4.32	.0008	.0122	.0028	.17	1.7
Rutland,	Muschopauge Lake,	.07	2.76	.0028	.0181	.0066	.32	1.1
Salem,	Wenham Lake,	.37	7.21	.0121	.0252	.0050	.92	2.2
	Longham Reservoir,	1.29	7.84	.0250	.0501	.0143	1.00	1.8
Shelburne,	Fox Brook,	.07	5.85	.0009	.0051	.0004	.12	3.6
Southbridge,	Hatchet Brook Reservoir No. 3,	.18	3.21	.0038	.0169	.0024	.20	1.0
	Hatchet Brook Reservoir No. 4,	.22	2.84	.0044	.0218	.0028	.21	0.9
South Hadley,	Leaping Well Reservoir,	.08	3.07	.0093	.0169	.0061	.18	1.0
	Buttery Brook Reservoir,	.11	4.50	.0086	.0123	.0025	.33	1.1
Spencer,	Shaw Pond,	.09	2.65	.0023	.0153	.0010	.23	1.1
Springfield,	Westfield Little River, filtered,	.20	3.72	.0014	.0082	–	.16	1.4
Stockbridge,	Lake Averic,	.12	7.42	.0015	.0173	.0024	.10	4.9
Stoughton,	Muddy Pond Brook,	.22	3.08	.0013	.0125	.0033	.39	0.9
Taunton,	Assawompsett Pond,	.22	3.83	.0045	.0180	.0041	.52	0.8
	Elder's Pond,	.14	3.86	.0032	.0173	.0021	.51	0.9
Wakefield,	Crystal Lake,	.21	6.48	.0114	.0273	.0034	.83	2.0
Wareham (Onset),	Jonathan Pond,	.03	2.84	.0010	.0094	.0012	.69	0.5
Wayland,	Snake Brook Reservoir,	.76	4.63	.0093	.0432	.0065	.35	1.3
Westfield,	Montgomery Reservoir,	.34	3.59	.0042	.0159	.0016	.14	1.1
	Tillotson Brook Reservoir,	.16	3.20	.0052	.0105	.0025	.16	1.1
West Springfield,	Bear Hole Brook, filtered,	.02	9.40	.0022	.0045	–	.19	3.6
Weymouth,	Great Pond,	1.04	4.02	.0032	.0216	.0030	.47	0.6
Williamsburg,	Reservoir,	.12	4.80	.0006	.0076	.0000	.12	2.0
Williamstown,	Reservoirs,	.04	8.35	.0011	.0061	.0008	.11	5.9
Winchester,	North Reservoir,	.12	3.79	.0041	.0164	.0032	.44	1.5
	South Reservoir,	.09	3.77	.0034	.0161	.0041	.39	1.4
	Middle Reservoir,	.17	3.61	.0046	.0223	.0037	.45	1.5
Worcester,	Bottomly Reservoir,	.24	3.85	.0065	.0172	.0023	.23	1.6
	Kent Reservoir,	.19	3.22	.0036	.0159	.0025	.24	1.5
	Leicester Reservoir,	.15	3.37	.0061	.0157	.0021	.21	1.2
	Mann Reservoir,	.16	3.72	.0025	.0137	.0015	.24	1.4
	Upper Holden Reservoir,	.14	3.83	.0036	.0129	.0018	.23	1.1
	Lower Holden Reservoir,	.13	2.90	.0045	.0118	.0014	.20	1.2

Averages of Chemical Analyses of Ground-water Sources for the Year 1918.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as —		Hardness.	Iron.
				Free.	Albuminoid.		Nitrates.	Nitrites.		
Acton,	Tubular wells,	.00	9.13	.0007	.0027	.70	.1433	.0000	3.6	.007
Amesbury,	Tubular wells,	.15	15.02	.0019	.0044	.56	–	–	8.0	.103
Ashland,	Tubular wells,	.00	4.55	.0007	.0021	.43	–	–	1.5	.008
Attleboro,	Large well,	.08	5.18	.0005	.0058	.62	.0120	.0000	1.8	.009
Avon,	Wells,	.00	6.54	.0019	.0045	.57	.1667	.0000	2.1	.006
Ayer,	Large well,	.01	6.20	.0004	.0047	.62	.0560	.0000	2.9	.014
	Tubular wells,	.04	6.73	.0001	.0030	.35	.0160	.0003	2.8	.019
Barnstable,	Tubular wells,	.00	4.30	.0005	.0025	1.15	–	–	0.5	.016
Bedford,	Large well,	.08	4.04	.0012	.0028	.35	–	–	1.6	.023
Billerica,	Tubular wells,	.21	7.58	.0022	.0065	.46	–	–	2.9	.172
Braintree,	Filter-gallery,	.55	6.40	.0033	.0211	.91	.0167	.0000	1.9	.062
Bridgewater,	Wells,	.00	5.13	.0005	.0022	.65	.0316	.0000	1.7	.016
Brookfield (East),	Tubular wells,	.00	3.63	.0007	.0019	.22	–	–	0.7	.005
Brookline,	Tubular wells and filter-gallery, filtered.	.16	9.55	.0009	.0079	.79	.0335	.0000	4.1	.011
Chelmsford (North),	Tubular wells,	.13	5.45	.0156	.0100	.47	.0380	.0001	1.9	.013
Chelmsford (Center),	Tubular wells,	.00	8.86	.0004	.0016	.72	.1660	.0001	2.9	.007
Chicopee (Fairview),	Tubular wells,	.08	5.92	.0007	.0022	.23	.0687	.0005	1.7	.044
Cohasset,	Tubular wells No. 2,	.03	14.62	.0010	.0052	2.01	.1830	.0000	5.6	.013
	Filtered water,	.16	8.17	.0020	.0107	1.22	.0062	.0001	2.7	.027
Dedham,	Large well and tubular wells.	.08	9.61	.0022	.0062	1.05	.1280	.0001	4.0	.008
Deerfield (Fire District).	Wells,	.00	6.77	.0005	.0049	.14	–	–	3.0	.011
Douglas,	Tubular wells,	.00	4.33	.0009	.0019	.40	.0553	.0000	1.8	.066
Dracut (Water Supply District).	Tubular wells,	.00	8.27	.0003	.0013	.56	.0997	.0000	3.6	.007
Dracut (Collinsville).	Tubular wells,	.05	6.77	.0006	.0059	.34	.0247	.0000	2.6	.008
Dudley,	Tubular wells,	.00	3.53	.0003	.0023	.27	–	–	1.1	.004
Duxbury,	Tubular wells,	.00	4.70	.0007	.0027	.85	–	–	0.6	.006
Easthampton,	Tubular wells,	.00	6.40	.0003	.0017	.16	.0260	.0000	3.8	.008
Easton,	Well,	.00	5.18	.0005	.0033	.55	.0524	.0000	1.7	.010
Edgartown,	Large well,	.00	3.07	.0003	.0027	.96	–	–	0.2	.005
Fairhaven,	Tubular wells,	.42	7.70	.0016	.0115	1.09	.0263	.0000	2.3	.013
Foxborough,	Tubular wells,	.01	5.07	.0005	.0016	.51	.0460	.0000	1.6	.014
Framingham,	Filter-gallery,	.04	11.53	.0165	.0076	1.83	.0176	.0003	4.8	.010
Franklin,	Tubular wells,	.00	5.18	.0006	.0028	.60	.0410	.0000	1.7	.007
Grafton,	Filter-gallery,	.03	10.97	.0005	.0036	1.56	.1200	.0000	4.1	.068

Averages of Chemical Analyses of Ground-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as —		Hardness.	Iron.
				Free.	Albuminoid.		Nitrates.	Nitrites.		
Granville,	Well,	.02	4.17	.0003	.0031	.29	–	–	1.5	.015
Groton,	Large well,	.00	7.30	.0009	.0025	.24	.0000	.0000	3.5	.014
Groton (West Groton Water Supply District).	Tubular wells,	.00	4.42	.0003	.0023	.20	–	–	2.8	.012
Hingham,	Wells,	.36	6.43	.0171	.0129	.81	–	–	1.9	.028
Holliston,	Large well,	.50	5.85	.0057	.0197	.44	.0060	.0000	1.6	.072
Hopkinton,	Tubular wells,	.00	12.27	.0023	.0042	1.11	.3100	.0001	5.0	.015
Kingston,	Tubular wells,	.00	4.43	.0009	.0031	.74	–	–	1.0	.004
Leicester,	Wells,	.11	6.17	.0005	.0045	.34	.0733	.0000	2.1	.013
Leicester (Cherry Valley and Rochdale Water Supply District).	Wells,	.11	5.47	.0086	.0067	.33	–	–	2.4	.009
Littleton,	Tubular wells,	.00	4.53	.0005	.0014	.24	.0250	.0000	1.8	.008
Lowell,	Boulevard wells (tubular),	.56	7.62	.0480	.0081	.46	.0263	.0001	2.8	.344
Manchester,	Wells,	.01	13.23	.0004	.0023	2.05	.1733	.0000	3.9	.017
Mansfield,	Large well,	.00	5.17	.0005	.0026	.47	.0460	.0000	1.6	.006
Marion,	Tubular wells,	.00	4.42	.0004	.0017	.67	.0250	.0000	1.0	.009
Mattapoisett,	Tubular wells,	.00	6.52	.0006	.0027	.86	.0343	.0000	2.4	.004
Medfield,	Spring,	.00	3.80	.0007	.0033	.33	.0053	.0000	1.2	.012
Medway,	Tubular wells,	.00	6.10	.0009	.0027	.62	.0310	.0002	2.4	.005
Merrimac,	Tubular wells,	.00	6.87	.0006	.0023	.53	.0247	.0000	2.8	.010
Methuen,	Tubular wells,	.32	6.99	.0044	.0114	.48	.0216	.0000	3.0	.054
Middleborough,	Well,	.55	7.33	.0090	.0094	.65	.0305	.0000	2.3	.355
	Filtered water,	.13	6.18	.0005	.0059	.65	.0260	.0000	2.3	.019
Millbury,	Well,	.01	4.60	.0008	.0041	.36	.0210	.0000	1.6	.006
Millis,	Spring,	.00	10.80	.0005	.0023	.81	.2600	.0000	4.4	.007
Monson,	Large well,	.08	3.66	.0008	.0042	.22	–	–	0.9	.006
Natick,	Large well,	.00	9.23	.0011	.0046	.83	.0273	.0000	4.4	.007
Needham,	Wells,	.01	6.72	.0006	.0031	.74	.1167	.0000	2.5	.016
	Hicks Spring,	.00	7.25	.0010	.0030	.78	.1875	.0000	2.4	.006
Newburyport,	Wells and Artichoke River, filtered.	.20	7.42	.0062	.0136	.81	.0205	.0000	2.8	.046
Newton,	Tubular wells and filter-gallery.	.01	6.60	.0007	.0041	.51	.0478	.0001	2.7	.007
No. Attleborough,	Wells,	.04	6.77	.0015	.0043	.49	.0260	.0000	2.1	.014
Norton,	Tubular wells,	.00	4.35	.0002	.0017	.39	–	–	1.4	.014
Norwood,	Tubular wells,	.14	9.20	.0024	.0059	.60	.0371	.0000	3.7	.033
Oak Bluffs,	Springs,	.00	4.65	.0013	.0027	.99	.0100	.0000	0.5	.010

Averages of Chemical Analyses of Ground-water Sources, etc. — Concluded.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as —		Hardness.	Iron.
				Free.	Albuminoid.		Nitrates.	Nitrites.		
Oxford,	Tubular wells,	.00	5.25	.0006	.0028	.35	.0580	.0000	1.8	.002
Palmer (Bondsville),	Tubular wells,	.00	5.70	.0008	.0023	.23	.0213	.0000	2.1	.010
Pepperell,	Tubular wells,	.00	3.00	.0006	.0021	.21	–	–	1.4	.005
Plainville,	Tubular wells,	.00	5.15	.0013	.0022	.42	–	–	2.2	.020
Provincetown,	Tubular wells in Truro,	.00	35.30	.0004	.0019	14.04	–	–	8.1	.021
Reading,	Filter-gallery,	.58	9.97	.0171	.0164	1.36	.0122	.0001	2.9	.350
	Filtered water,	.20	17.20	.0011	.0097	1.08	.0132	.0007	7.7	.050
Salisbury,	Well,	.22	8.30	.0007	.0058	.60	–	–	3.5	.020
Scituate,	Tubular wells,	.00	15.63	.0007	.0026	3.33	.2083	.0000	5.6	.006
Sharon,	Well,	.04	14.60	.0004	.0029	1.89	.2667	.0000	5.8	.009
	Tubular wells,	.00	5.67	.0010	.0027	.52	.0390	.0000	2.2	.004
Sheffield,	Spring,	.00	4.30	.0060	.0028	.10	.0080	.0000	1.6	.005
Shirley,	Well,	.00	4.47	.0008	.0019	.45	.1250	.0000	1.4	.010
Shrewsbury,	Wells,	.00	3.60	.0007	.0035	.37	.0230	.0000	1.6	.006
South Hadley (Fire District No. 2).	Large well,	.02	4.90	.0006	.0024	.17	.0327	.0000	2.1	.011
Tisbury,	Well,	.00	4.12	.0003	.0031	.96	.0050	.0000	0.5	.011
Uxbridge,	Tubular wells,	.00	6.10	.0003	.0018	.55	.0400	.0000	1.8	.006
Walpole,	Tubular wells,	.00	4.10	.0005	.0022	.49	.0425	.0000	1.7	.009
Waltham,	Old well,	.17	8.63	.0046	.0040	.83	.0181	.0000	3.6	.075
	New well,	.00	8.38	.0013	.0035	.65	.0207	.0000	3.6	.005
Ware,	Wells,	.00	7.52	.0006	.0022	.51	.1600	.0001	2.6	.011
Wareham (Fire District).	Tubular wells,	.00	3.05	.0005	.0030	.59	–	–	0.6	.014
Warren (West),	Large well,	.00	5.27	.0003	.0014	.20	–	–	2.0	.004
Webster,	Wells,	.05	3.60	.0007	.0074	.36	.0120	.0000	1.3	.007
Wellesley,	Tubular wells,	.00	9.55	.0007	.0026	1.15	.0693	.0000	4.0	.013
	Well at Williams Spring,	.00	15.25	.0007	.0030	1.19	.5500	.0000	5.0	.007
	Filter-gallery,	.00	9.32	.0009	.0036	1.03	.0872	.0000	3.9	.003
Westborough,	Filter basin,	.05	3.69	.0013	.0096	.29	–	–	1.3	.017
West Brookfield,	Tubular wells,	.00	4.43	.0003	.0017	.30	.0583	.0000	1.4	.007
Westford,	Tubular wells,	.00	4.60	.0000	.0024	.18	–	–	1.7	.002
Weston,	Well,	.28	7.42	.0017	.0103	.60	.0383	.0000	2.7	.008
Winchendon,	Wells,	.08	3.66	.0023	.0043	.17	–	–	1.0	.144
Woburn,	Filter-gallery,	.01	12.04	.0019	.0073	1.48	.0328	.0001	5.0	.005
Worthington,	Springs,	.09	4.00	.0007	.0049	.13	–	–	1.8	.074
Wrentham,	Tubular wells,	.00	4.45	.0008	.0030	.40	.0480	.0000	1.6	.009

Water Supply Statistics.

In the year 1918 a water supply was introduced in the small town of Dunstable, which had a population of 362 by the census of 1915. There was very little other water works construction during the year. Of the 354 cities and towns in Massachusetts, 213, including all of the 37 cities and 176 of the towns, are provided with public water supplies. The following table gives a classification by population (census of 1915) of the cities and towns having and not having public water supplies at the end of the year: —

Population, 1915.	Number of Places of Given Population having Public Water Supplies.	Total Population of Places in Preceding Column.	Number of Places of Given Population not having Public Water Supplies.	Total Population of Places in Preceding Column.
Under 500,	1	362	39	12,908
500–999,	7	5,229	36	27,536
1,000–1,499,	21	27,759	24	29,589
1,500–1,999,	12	21,685	20	33,947
2,000–2,499,	17	37,819	10	22,002
2,500–2,999,	20	54,895	6	16,013
3,000–3,499,	6	19,928	3	9,920
3,500–3,999,	8	30,123	–	–
Above 4,000,	121	3,329,981	3	13,614
Totals,	213	3,527,781	141	165,529

The 213 cities and towns having public water supplies are classified in the following table according to the dates when a fairly complete system of water supply was first introduced: —

Years.	Number of Public Water Supplies introduced.	Years.	Number of Public Water Supplies introduced.
Previous to 1850,	5	1890–1899, inclusive,	34
1850–1859, inclusive,	4	1900–1909, inclusive,	21
1860–1869, inclusive,	9	1910–1918, inclusive,	25
1870–1879, inclusive,	45	Total,	213
1880–1889, inclusive,	70		

The first table presented shows that although but 60 per cent of the cities and towns in the State are provided with public water supplies,

the total population of the places supplied is 96 per cent of the total population of the State. The populations given in this table were obtained by using the total population of the cities and towns supplied, and is somewhat greater than the actual number of persons to whom the public water supply is available, but the difference is not great. With the exception of the town of Tewksbury, all of the towns in the State having a population in excess of 5,000 are now supplied with water, and there are only 12 towns having a population in excess of 2,500 which are not provided with public water supplies. These towns are as follows: —

Town.	Population.	Town.	Population.
Tewksbury,	5,265	Sutton,	2,829
Warren,	4,268	Seekonk,	2,767
Templeton,	4,081	Bourne,	2,672
Somerset,	3,377	Hanover,	2,666
Auburn,	3,281	Swansea,	2,558
Westport,	3,262	Wilbraham,	2,521

At the present time the water works are owned either by the municipality or by a water, water supply or fire district in all of the cities and 133 of the towns, while in 43 towns the works are owned by private companies. The following table gives the classification by population of the cities and towns which own their water works and those which are supplied with water by private companies: —

Population, 1915.	Cities and Towns owning Water Works.		Cities and Towns supplied with Water by Private Companies.	
	Number.	Total Population.	Number.	Total Population.
Under 1,000,	4	2,263	4	3,328
1,000–1,999,	23	33,846	10	15,598
2,000–2,999,	28	69,407	9	23,307
3,000–3,999,	8	28,942	6	21,109
4,000–4,999,	7	31,251	2	9,476
5,000–5,999,	16	88,166	3	16,117
6,000–6,999,	10	66,316	3	18,778
7,000–7,999,	7	52,937	–	–
Over 8,000,	67	2,979,893	6	67,047
Total,	170	3,353,021	43	174,760

The tendency toward municipal ownership of water works is shown in the following table, giving, for the census years since 1890, the total population of all cities and towns supplied with water, and the total population of those supplied by private companies with its percentage of the total population of all places supplied: —

Year.	Total Population of All Cities and Towns provided with Public Water Supplies.	Population of Towns supplied by Private Companies.	Per Cent of Total Population supplied with Water.
1890,	1,924,812	318,319	16.5
1895,	2,237,017	212,579	9.5
1900,	2,565,301	236,869	9.2
1905,	2,792,490	193,290	6.9
1910,	3,171,055	159,730	5.0
1915,	3,528,769	174,760	5.0

The foregoing table shows that the total population of the towns supplied with water by private companies is only 5 per cent of the total population of all the cities and towns supplied with water. There are only 12 towns having a population in excess of 5,000 which are supplied by private companies. These towns are as follows: —

Town.	Population, 1915.	Town.	Population, 1915.
Southbridge,	14,217	Fairhaven,	6,277
Milford,	13,684	Ludlow,	6,251
Dedham,	11,043	Grafton,	6,250
Palmer,	9,468	Amherst,	5,558
Bridgewater,	9,381	Millbury,	5,295
Northbridge,	9,254	Hingham,	5,264

In the annual report of the State Department of Health for the year 1915 (pages 296 to 306) a table will be found showing the population and valuation of all of the cities and towns in Massachusetts in 1915, together with certain other information relative to the ownership of the water works and the date of their introduction into those places so provided.

Consumption of Water.

Records of the consumption of water are kept in nearly all of the cities and towns where water is pumped, while in several places supplied by gravity venturi meters have been installed to measure the consumption.

The winter of 1917–18 was far more severe than any experienced in Massachusetts since the general introduction of water supplies was begun, and a great many service pipes and even supply mains became frozen. After the first severe cold in December, 1917, faucets were generally allowed to run continuously in many places, often at the suggestion of the water departments, and quantities of water far in excess of the ordinary consumption were used by most of the cities and towns. Under these conditions reservoirs became depleted, and there were serious shortages of water in many places. It is also notable that in many cities and towns the water consumption in the spring months was much greater than in the same months of the previous year, the increases ranging as high as 25 per cent. This increase is probably due largely to leakage caused by the freezing of pipes. With the limited resources of the water departments due to the war, it has not been practicable in many places to make the repairs and improvements required to reduce the consumption to the normal amount.

The following table gives statistics with regard to the consumption of water in the year 1918 in those cities and towns from which records could be obtained. The populations given in the table were obtained by adding three-fifths of the increase in population between 1910 and 1915 to the population as determined by the census of the latter year. The daily consumption of water per inhabitant has been obtained by dividing the average daily consumption by the estimated total population of the city or town in 1918. The quantity obtained in this manner is somewhat less than the actual consumption per person using the water, because there are in all cities and towns a greater or less number of persons who do not use the public supply. The difference between the number of inhabitants and the number of consumers would account, to a large extent, for the low rate per inhabitant in some of the towns which contain villages to which the public water supply has not been extended, and in towns where the works have been in operation but a short time, and in which, in consequence, water has not come into general use. In certain of the towns the population during the summer months is much greater than is shown by the census returns, and in such cases the consumption per inhabitant as given in the table is higher than it would be if allowance were made for the increased population in the summer. With a few exceptions, however, the difference between the census returns and the actual population supplied is not great.

Consumption of Water in Various Cities and Towns in 1918.

City or Town.	Estimated Population.	Average Daily Consumption.		City or Town.	Estimated Population.	Average Daily Consumption.	
		Gallons.	Gallons per Inhabitant.			Gallons.	Gallons per Inhabitant.
Metropolitan Water District: —	1,241,460	129,764,000	105	Canton,	6,119	393,000	64
Arlington,	17,110	1,290,300	75	Chelmsford,	5,285	132,000	25
Belmont,	9,604	577,700	60	Clinton,	13,262	726,000	55
Boston,	781,047	94,634,000	121	Concord,	6,837	623,000	91
Chelsea,	50,010	3,501,200	70	Danvers and Middleton.	13,654	1,760,000	129
Everett,	40,258	3,365,800	84	Dedham,	12,098	1,133,000	94
Lexington,	5,910	494,600	84	Dudley,	4,437	181,000	41
Malden,	51,609	3,254,700	63	Duxbury,	2,061	78,000	38
Medford,	34,924	2,161,200	62	East Longmeadow,	2,171	27,000	12
Melrose,	17,579	1,180,600	67	Easthampton,	10,638	767,000	72
Milton,	9,006	434,500	48	Easton,	5,019	179,000	36
Nahant,	1,509	228,200	151	Fairhaven,	6,970	330,000	47
Quincy,	45,493	4,632,100	102	Fall River,	128,089	6,344,000	50
Revere,	29,353	1,975,500	67	Falmouth,	4,381	420,000	96
Somerville,	92,625	7,433,200	80	Fitchburg,	40,754	4,396,000	108
Stoneham,	7,728	617,700	80	Framingham,	17,607	1,174,000	67
Swampscott,	8,030	606,100	76	Franklin,	6,919	439,000	63
Watertown,	18,699	2,434,700	130	Gloucester,	24,526	1,696,000	69
Winthrop,	14,334	941,900	66	Greenfield,	13,933	1,505,000	108
Agawam,	5,187	128,000	25	Groton,	2,440	110,000	45
Amesbury,	7,732	775,000	100	Holliston,	2,834	109,000	38
Andover,	8,384	655,000	78	Holyoke,	62,668	7,200,000	115
Ashland,	2,199	81,000	37	Hudson,	6,767	450,000	66
Athol,	10,531	907,000	86	Ipswich,	6,569	377,000	57
Attleboro,	19,839	1,435,000	72	Lancaster,	2,658	81,000	31
Avon,	2,255	104,000	46	Lawrence,	92,879	4,475,000	43
Barnstable,	5,186	167,000	32	Lenox,	3,351	300,000	90
Bedford,	1,445	47,000	33	Lincoln,	1,391	294,000	212
Beverly,	25,544	1,909,000	75	Littleton,	1,228	53,000	43
Billerica,	3,520	397,000	113	Longmeadow,	2,201	91,000	41
Braintree,	10,109	722,000	71	Lowell,	126,000	7,544,000	60
Bridgewater,	10,397	256,000	25	Lynn and Saugus,	111,217	8,374,000	75
Brockton,	65,534	2,985,000	46	Manchester,	3,108	324,000	104
Brookline,	36,909	3,144,000	85	Mansfield,	6,125	764,000	125
Cambridge,	111,212	11,127,000	100	Marblehead,	7,767	621,000	80

Consumption of Water in Various Cities and Towns in 1918 — Concluded.

City or Town.	Estimated Population.	Average Daily Consumption.		City or Town.	Estimated Population.	Average Daily Consumption.	
		Gallons.	Gallons per Inhabitant.			Gallons.	Gallons per Inhabitant.
Marion,	1,503	92,000	61	Randolph and Holbrook.	8,021	527,000	66
Marlborough,	15,653	659,000	42	Reading,	7,397	279,000	38
Mattapoisett,	1,423	79,000	56	Rockport,	4,435	268,000	60
Maynard,	6,998	366,000	52	Salem,	47,000	4,995,000	106
Merrimac,	2,040	123,000	60	Salisbury,	1,752	115,000	66
Methuen,	15,542	952,000	61	Sharon,	2,563	215,000	84
Middleborough,	8,881	444,000	50	Shirley,	2,318	81,000	35
Milford and Hopedale.	17,009	807,000	48	Shrewsbury,	3,303	75,000	23
Millbury,	5,628	286,000	51	Southbridge,	15,192	1,016,000	67
Millis,	1,468	50,700	35	Springfield,	111,398	12,970,000	116
Montague and Erving.	9,740	790,000	81	Taunton,	37,302	3,154,000	85
Nantucket,	3,288	249,000	76	Tisbury,	1,401	148,000	106
Natick,	11,871	742,000	63	Wakefield,	13,607	786,000	58
Needham,	7,452	462,000	62	Walpole,	5,849	1,209,000	207
New Bedford,	117,318	9,716,000	83	Waltham,	31,546	2,510,000	80
Newburyport,	15,528	1,380,000	89	Wareham,	5,820	176,000	30
Newton,	45,097	3,426,000	76	Webster,	13,199	788,000	60
North Andover,	6,212	402,000	65	Wellesley,	7,055	545,000	78
North Attleborough,	9,300	475,000	51	West Brookfield,	1,265	37,000	29
Norton,	2,613	173,000	66	Westfield,	19,831	2,331,000	118
Norwood,	12,755	1,532,000	120	Westford,	2,838	167,000	59
Oak Bluffs,	1,342	186,000	139	Weston,	2,484	149,000	60
Orange,	5,437	161,000	30	Weymouth,	14,613	1,445,000	99
Peabody,	20,367	3,533,000	173	Whitman,	7,657	256,000	33
Pepperell,	2,771	143,000	52	Woburn,	17,071	2,320,000	136
Pittsfield,	44,099	5,683,000	129	Worcester,	172,724	15,719,000	91
Plainville,	1,422	45,000	32	Wrentham,	2,817	145,000	51
Plymouth,	13,397	1,563,000	117				

Rainfall.

The normal yearly rainfall in Massachusetts as deduced from long-continued observations in various parts of the State is 44.46 inches. The average rainfall for the year 1918 in these places was 37.68 inches, a deficiency of 6.78 inches. The year was the fifteenth in succession in

which the rainfall has been less than the normal, the accumulated deficiency at the end of the year being 59.08 inches, or 14.62 inches more than the total rainfall in a normal year. The rainfall in January was normal, there was an excess of precipitation in the months of June and September, and a deficiency in the other nine months of the year. The greatest excess in any month occurred in September, when the average rainfall was 7.28 inches, or 3.82 inches greater than the normal, and the greatest deficiency occurred in October, when the average rainfall was 1.03 inches, or 2.77 inches less than the normal.

The following table gives the normal rainfall in the State for each month as deduced from observations at various places for a long period of years, together with the average rainfall at those places for each month during the year 1918 and the departure from the normal: —

Month.	Normal Rainfall (Inches).	Rainfall in 1918 (Inches).	Excess or Deficiency in 1918 (Inches).	Month.	Normal Rainfall (Inches).	Rainfall in 1918 (Inches).	Excess or Deficiency in 1918 (Inches).
January,	3.73	3.73	—.00	August,	4.22	2.26	—1.96
February,	3.60	2.98	—.62	September,	3.46	7.28	+3.82
March,	3.88	2.61	—1.27	October,	3.80	1.03	—2.77
April,	3.59	3.38	—.21	November,	3.79	2.46	—1.33
May,	3.67	1.88	—1.79	December,	3.67	3.35	—.32
June,	3.25	3.35	+.10	Totals,	44.46	37.68	—6.78
July,	3.80	3.37	—.43				

Flow of Streams.

Sudbury River.

The average flow of the Sudbury River during the year 1918 was 736,000 gallons per day per square mile of drainage area, or about 76 per cent of the normal flow for the past forty-four years. The flow was in excess of the normal in the months of February and September, but less than the normal in the other ten months of the year. The greatest excess occurred in the month of September and the greatest deficiency in the month of January. The average flow for the driest six months, July to December, inclusive, was 269,000 gallons per day per square mile, or 72 per cent of the normal flow for such period during the past forty-four years.

In order to show the relation between the flow of the Sudbury River during each month of the year 1918 and the normal flow of that

stream, as deduced from observations during forty-four years, from 1875 to 1918, inclusive, the following table has been prepared. The drainage area of the Sudbury River above the point of measurement is 75.2 square miles.

Table showing the Average Daily Flow of the Sudbury River for Each Month in the Year 1918, in Cubic Feet per Second per Square Mile of Drainage Area, and in Million Gallons per Day per Square Mile of Drainage Area; also, Departure from the Normal Flow.

Month.	Normal Flow.		Actual Flow in 1918.		Excess or Deficiency.	
	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.
January,	1.784	1.153	.422	.273	—1.362	—.880
February,	2.565	1.658	2.798	1.809	+.233	+.151
March,	4.158	2.688	3.384	2.187	—.774	—.501
April,	3.056	1.976	2.267	1.466	—.789	—.510
May,	1.646	1.064	.989	.639	—.657	—.425
June,	.759	.491	.286	.185	—.473	—.306
July,	.277	.179	.149	.096	—.128	—.083
August,	.365	.236	—.083	—.054	—.448	—.290
September,	.344	.222	.986	.637	+.642	+.415
October,	.634	.410	.424	.274	—.210	—.136
November,	1.117	.722	.756	.489	—.361	—.233
December,	1.462	.945	1.451	.938	—.011	—.007
Average for whole year,	1.508	.975	1.139	.736	—.369	—.239

In the annual report of the State Department of Health for the year 1915 (pages 312 to 318) tables were presented giving the record of the rainfall upon the drainage area of the Sudbury River and the yield expressed in inches in depth upon the drainage area (inches of rainfall collected) for each of the forty-one years from 1875 to 1915, inclusive. The corresponding record for the years 1916, 1917 and 1918, together with the average for the entire period of forty-four years, is given in the following table: —

Rainfall, in Inches, received and collected on the Sudbury River Drainage Area.

Month.	1916.			1917.		
	Rainfall.	Rainfall collected.	Per Cent collected.	Rainfall.	Rainfall collected.	Per Cent collected.
January,	1.53	1.680	109.8	3.50	.909	25.9
February,	5.91	2.262	38.2	2.68	1.216	45.5
March,	4.16	3.245	78.1	4.96	3.940	79.4
April,	4.19	5.243	125.1	2.41	2.425	100.5
May,	3.43	2.567	74.9	4.93	2.632	53.4
June,	4.77	2.068	43.4	4.23	1.802	42.7
July,	5.17	1.044	20.2	1.11	.076	6.8
August,	2.01	.139	6.9	6.40	.361	5.6
September,	1.80	.044	2.5	1.52	.100	6.6
October,	1.49	—.009	—.6	5.65	.860	15.2
November,	2.28	.189	8.3	1.31	.757	57.6
December,	3.22	.562	17.4	2.81	.678	24.2
Totals and averages,	39.96	19.034	47.6	41.51	15.756	38.0

Month.	1918.			Mean for Forty-four Years, 1875–1918.		
	Rainfall.	Rainfall collected.	Per Cent collected.	Rainfall.	Rainfall collected.	Per Cent collected.
January,	3.47	.486	14.0	4.05	2.057	50.9
February,	3.58	2.914	81.3	4.12	2.693	65.4
March,	2.50	3.896	156.2	4.32	4.794	110.9
April,	4.43	2.530	57.1	3.56	3.410	96.8
May,	1.16	1.141	98.8	3.27	1.898	58.0
June,	3.65	.319	8.7	3.10	.847	27.3
July,	4.07	.171	4.2	3.64	.319	8.8
August,	1.61	—.096	—6.0	3.86	.421	10.9
September,	8.60	1.100	12.8	3.37	.384	11.4
October,	1.04	.490	47.0	3.77	.730	19.4
November,	2.75	.843	30.7	3.65	1.247	34.2
December,	3.68	1.673	45.5	3.80	1.686	44.3
Totals and averages,	40.54	15.467	38.2	44.51	20.486	46.0

The following table gives the record of the yield of the drainage area of the Sudbury River for each of the last three years, the flow being

expressed in gallons per day per square mile of drainage area in order to render the table more convenient for use in estimating the probable yield of drainage areas used as sources of water supply: —

Yield of the Sudbury River Drainage Area in Gallons per Day per Square Mile.[1]

Month.	1916.	1917.	1918.	Mean for Forty-four Years, 1875–1918.
January,	942,000	510,000	273,000	1,153,000
February,	1,356,000	755,000	1,809,000	1,658,000
March,	1,820,000	2,209,000	2,187,000	2,688,000
April,	3,037,000	1,405,000	1,466,000	1,976,000
May,	1,439,000	1,476,000	639,000	1,064,000
June,	1,198,000	1,044,000	185,000	491,000
July,	585,000	43,000	96,000	179,000
August,	78,000	202,000	—54,000	236,000
September,	26,000	58,000	637,000	222,000
October,	—5,000	482,000	274,000	410,000
November,	110,000	438,000	489,000	722,000
December,	315,000	380,000	938,000	945,000
Average for whole year,	904,000	750,000	736,000	975,000
Average for driest six months,	186,000	267,000	269,000	375,000

[1] The drainage area of the Sudbury River used in making up these records included water surfaces amounting to about 2 per cent of the whole area, from 1875 to 1878, inclusive, subsequently increasing by the construction of storage reservoirs to about 3 per cent in 1879, to 3.5 per cent in 1885, to 4 per cent in 1894 and to 6.5 per cent in 1898. The drainage area also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

Nashua River.

The average flow of the South Branch of the Nashua River above Clinton during the year 1918 was 902,000 gallons per day per square mile of drainage area, or 85 per cent of the normal flow for the past twenty-two years. The flow was in excess of the normal in the months of February, March and September, and less than the normal in the other nine months of the year. The greatest excess occurred in the month of February and the greatest deficiency in the month of January. The average flow for the driest six months, May to November, inclusive, was 412,000 gallons per day per square mile, or about 79 per cent of the normal flow for such a period during the past twenty-two years.

In order to show the relation between the flow of the Nashua River

during each month of the year 1918 and the normal flow of that stream as deduced from observations during twenty-two years, from 1897 to 1918, inclusive, the following table has been prepared. The drainage area of the Nashua River above the point of measurement was 119 square miles from 1897 to 1907, and 118.19 square miles from 1908 to 1913, inclusive. Since Jan. 1, 1914, the city of Worcester has been diverting water from 9.35 square miles of this drainage area for the supply of that city, leaving the net drainage area 108.84 square miles. In the calculations of yield allowance has been made for water overflowing from the Worcester area.

Table showing the Average Daily Flow of the South Branch of the Nashua River for Each Month in the Year 1918, in Cubic Feet per Second per Square Mile of Drainage Area, and in Million Gallons per Day per Square Mile of Drainage Area; also, Departure from the Normal Flow.

Month.	Normal Flow.		Actual Flow in 1918.		Excess or Deficiency.	
	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.
January,	1.821	1.177	.749	.484	—1.072	—.693
February,	2.190	1.416	3.131	2.024	+.941	+.608
March,	3.945	2.550	4.008	2.590	+.063	+.040
April,	3.272	2.115	2.487	1.608	—.785	—.507
May,	1.824	1.179	1.042	.673	—.782	—.506
June,	1.203	.778	.809	.523	—.394	—.255
July,	.663	.429	.433	.280	—.230	—.149
August,	.644	.416	.246	.159	—.398	—.257
September,	.509	.329	.933	.603	+.424	+.274
October,	.746	.482	.528	.341	—.218	—.141
November,	1.091	.706	.900	.582	—.191	—.124
December,	1.707	1.104	1.634	1.056	—.073	—.048
Average for whole year,	1.632	1.055	1.395	.902	—.237	—.153

In the annual report of the State Department of Health for the year 1915 (pages 324 to 327) tables were presented giving the record of the rainfall upon the drainage area of the Nashua River and the total yield expressed in inches in depth upon the drainage area (inches of rainfall collected) for each of the nineteen years from 1897 to 1915, inclusive. The corresponding record for the years 1916, 1917 and 1918, together

with the average for the entire period of twenty-two years, is given in the following table: —

Rainfall, in Inches, received and collected on the Nashua River Drainage Area.

Month.	1916.			1917.		
	Rainfall.	Rainfall collected.	Per Cent collected.	Rainfall.	Rainfall collected.	Per Cent collected.
January,	1.60	2.346	146.7	3.37	1.224	36.3
February,	5.98	3.030	50.7	3.05	1.476	48.3
March,	3.32	3.374	101.5	4.21	4.409	104.8
April,	3.65	5.696	156.0	1.80	2.535	140.6
May,	3.34	3.028	90.7	3.89	2.350	60.5
June,	6.57	3.546	53.9	4.47	2.122	47.4
July,	5.66	1.937	34.2	1.22	.471	38.8
August,	1.72	.506	29.5	4.46	.552	12.4
September,	4.21	.506	12.0	1.20	.144	12.0
October,	1.42	.250	17.6	6.03	.990	16.4
November,	3.15	.554	17.6	1.25	.540	43.1
December,	2.81	.820	29.2	2.31	.694	30.0
Totals and averages,	43.43	25.593	58.9	37.26	17.507	47.0

Month.	1918.			Mean for Twenty-two Years, 1897-1918.		
	Rainfall.	Rainfall collected.	Per Cent collected.	Rainfall.	Rainfall collected.	Per Cent collected.
January,	2.97	.864	29.1	3.62	2.100	58.0
February,	4.25	3.260	76.6	3.80	2.296	60.4
March,	2.24	4.614	206.0	4.03	4.549	112.8
April,	3.47	2.775	80.0	3.71	3.651	98.5
May,	1.07	1.201	112.8	3.28	2.103	64.2
June,	4.57	.902	19.8	3.76	1.342	35.7
July,	2.80	.499	17.8	4.04	.765	18.9
August,	2.82	.284	10.1	4.14	.742	17.9
September,	7.18	1.041	14.5	3.59	.567	15.8
October,	1.58	.609	38.6	3.38	.860	25.4
November,	3.08	1.004	32.6	3.27	1.218	37.3
December,	3.74	1.884	50.4	4.06	1.969	48.5
Totals and averages,	39.77	18.937	47.6	44.68	22.162	49.6

The following table gives a record of the yield of the drainage area of the Nashua River for each of the last three years, the flow being expressed in gallons per day per square mile of drainage area: —

Yield of the Nashua River Drainage Area in Gallons per Day per Square Mile.[1]

Month.	1916.	1917.	1918.	Mean for Twenty-two Years, 1897-1918.
January,	1,315,000	686,000	484,000	1,177,000
February,	1,816,000	916,000	2,024,000	1,416,000
March,	1,891,000	2,472,000	2,590,000	2,550,000
April,	3,300,000	1,468,000	1,608,000	2,115,000
May,	1,697,000	1,317,000	673,000	1,179,000
June,	2,054,000	1,229,000	523,000	778,000
July,	1,086,000	264,000	280,000	429,000
August,	284,000	309,000	159,000	416,000
September,	294,000	84,000	603,000	329,000
October,	140,000	555,000	341,000	482,000
November,	321,000	313,000	582,000	706,000
December,	460,000	389,000	1,056,000	1,104,000
Average for whole year,	1,215,000	834,000	902,000	1,055,000
Average for driest six months,	432,000	320,000	412,000	522,000

[1] The drainage area used in making up these records included water surfaces amounting to 2.2 per cent of the whole area from 1897 to 1902, inclusive, to 2.4 per cent in 1903, to 3.6 per cent in 1904, to 4.1 per cent in 1905, to 5.1 per cent in 1906, to 6 per cent in 1907, to 7 per cent in 1908, 1909 and 1910, to 6.5 per cent in 1911, to 6.8 per cent in 1912, to 7 per cent in 1913, to 7.4 per cent in 1914 and 1915, to 7.6 per cent in 1916 and to 7.4 per cent in 1917.

Merrimack River.

The flow of the Merrimack River has been measured for many years at Lawrence, above which place the river has a total drainage area of 4,663 square miles which includes 118[1] square miles on the South Branch of the Nashua River, 75 square miles on the Sudbury River and 18 square miles tributary to Lake Cochituate, or a combined area of 211[1] square miles from which water is drawn at the present time for the supply of the Metropolitan Water District. The flow as measured at Lawrence includes the water wasted from these three drainage areas, the quantity of which, in the wet months of the year, is very considerable, but which becomes very small in the dry months. Records of the quantity of water wasted have been kept by the Boston Water Board and by the Metropolitan Water and Sewerage Board, and these

[1] Including 9.35 square miles from which water is drawn for the supply of the city of Worcester.

quantities have been deducted from the flow as measured at Lawrence. In presenting the record of the flow of the river, these three drainage areas have been deducted from the total above Lawrence, so that the net drainage area above that point was 4,567 square miles in 1880, 4,570 square miles in the years 1881 to 1897, inclusive, and 4,452 square miles since the latter year.

The average flow of the Merrimack River during the year 1918 amounted to 1.198 cubic feet per second, or 775,000 gallons per day, per square mile of drainage area, or 82 per cent of the normal flow for the past thirty-nine years for which records are available. The flow was in excess of the normal in the months of September, October, November and December, and less than the normal in the other eight months of the year.

In order to show the relation between the flow of this stream during each month of the year 1918 and the normal flow as deduced from observations during the thirty-nine years from 1880 to 1918, inclusive, the following table has been prepared: —

Table showing the Average Monthly Flow of the Merrimack River at Lawrence for the Year 1918 in Cubic Feet per Second per Square Mile of Drainage Area; also, the Departure from the Normal Flow.

Month.	Normal Flow, 1880–1918.	Actual Flow in 1918.	Excess or Deficiency.
January,	1.284	.466	—.818
February,	1.415	.819	—.596
March,	2.696	1.983	—.713
April,	3.415	3.337	—.078
May,	2.171	1.540	—.631
June,	1.264	.757	—.507
July,	.746	.553	—.193
August,	.684	.470	—.214
September,	.651	.847	+.196
October,	.811	.991	+.180
November,	1.108	1.126	+.018
December,	1.216	1.492	+.276
Average for whole year,	1.455	1.198	—.257

The following table gives the record of the net flow of the Merrimack River at Lawrence for each of the last three years, the flow being expressed in cubic feet per second per square mile of net drainage area: —

Flow of the Merrimack River at Lawrence in Cubic Feet per Second per Square Mile.

Month.	1916.	1917.	1918.	Mean for Thirty-nine Years, 1880-1918.
January,	1.527	1.023	.466	1.284
February,	1.674	.770	.819	1.415
March,	1.735	2.316	1.983	2.696
April,	4.323	3.242	3.337	3.415
May,	2.733	2.124	1.540	2.171
June,	3.101	3.037	.757	1.264
July,	1.531	1.024	.553	.746
August,	.924	.629	.470	.684
September,	.972	.549	.847	.651
October,	.798	.613	.991	.811
November,	.743	.882	1.126	1.108
December,	1.154	.569	1.492	1.216
Average for whole year,	1.768	1.398	1.198	1.455
Average for driest six months,	1.020	.711	.791	.869

Sudbury, Nashua and Merrimack Rivers.

The following table shows the weekly fluctuations during the year 1918 in the flow of the three streams just described, namely, the Sudbury River at Framingham, the South Branch of the Nashua River above Clinton, and the Merrimack River at Lawrence. The flow of these streams, particularly that of the Sudbury and of the South Branch of the Nashua River, serves to indicate the flow of other streams in eastern Massachusetts. The area of the Sudbury River watershed is 75.2 square miles and of the South Branch of the Nashua River 118.19 square miles. The net watershed area of the Merrimack River is 4,452 square miles.

Table showing the Average Weekly Flow of the Sudbury, South Branch of the Nashua and the Merrimack Rivers for the Year 1918 in Cubic Feet per Second per Square Mile of Drainage Area.

Week ending Sunday —	Cubic Feet per Second per Square Mile.			Week ending Sunday —	Cubic Feet per Second per Square Mile.		
	Merrimack River at Lawrence.	Nashua River.	Sudbury River.		Merrimack River at Lawrence.	Nashua River.	Sudbury River.
Jan. 6,	.419	.347	.030	July 7,	.569	.457	.070
13,	.407	1.069	.931	14,	.569	.353	.138
20,	.500	1.046	.531	21,	.621	.603	.370
27,	.502	.621	.311	28,	.470	.086	—.079
Feb. 3,	.477	.541	.357	Aug. 4,	.393	.427	.148
10,	.473	.614	.160	11,	.451	.483	.086
17,	.575	1.485	2.444	18,	.684	.194	—.019
24,	1.202	5.956	4.724	25,	.427	.077	—.272
Mar. 3,	1.506	6.258	6.221	Sept. 1,	.352	.319	—.120
10,	1.277	3.828	2.900	8,	.345	.207	—.278
17,	1.036	2.913	3.938	15,	.367	.491	.446
24,	2.339	5.391	3.456	22,	.590	1.448	1.345
31,	3.493	3.590	2.092	29,	1.995	1.790	2.317
Apr. 7,	4.684	2.613	1.703	Oct. 6,	1.308	.765	.934
14,	2.899	2.167	1.661	13,	1.223	.498	.497
21,	3.113	2.772	2.514	20,	.783	.341	.200
28,	3.047	2.239	2.910	27,	.830	.369	.209
May 5,	2.448	2.377	2.719	Nov. 3,	1.062	.513	.411
12,	1.698	1.097	1.180	10,	.869	.651	.527
19,	1.636	.752	.848	17,	.715	.792	.373
26,	.964	.713	.356	24,	1.751	1.654	1.656
June 2,	.805	.659	.215	Dec. 1,	1.162	.733	.715
9,	.691	.538	.036	8,	.941	.811	.579
16,	.745	.743	—.013	15,	.880	1.961	1.497
23,	.634	1.519	.854	22,	1.761	1.796	1.878
30,	1.004	.552	.330	29,	2.445	2.221	2.020

Sewerage and Sewage Disposal.

The war has made it impossible to carry out all the usual inspections of sewer outlets and sewage disposal works during the year, and it has also made impracticable the construction of additions to the existing works.

Examination of Sewer Outlets discharging into the Sea.

No important changes have been made in the various sewer outlets discharging into the sea or tidal waters during the past year. Improvements are greatly needed at a number of these outlets, especially at the sewer outlet of the city of Lynn and at that of the city of Beverly, and a sewerage system is greatly needed in the town of Danvers to remove the objectionable sources of pollution of local waters in that town. The sewer outlet of the cities of Salem and Peabody also could

be materially improved at a comparatively small cost, but under the conditions existing during the past year it has not been practicable to undertake such improvements.

Sewage Disposal in the Nashua River Valley.

The installation of sewage disposal works at Fitchburg has been followed by a marked improvement in the condition of the North Branch of the Nashua River below that city, but this improvement is largely offset by the entrance of the sewage of Leominster farther down the stream, and the condition of the river above its confluence with the South Branch at Lancaster has grown steadily worse in the past three years.

At Clinton, on the South Branch, the sewage is treated at disposal works and the effluent discharged into the river just above its confluence with the North Branch. The examinations of the main river below the junction of the North and South Branches show that its condition is growing worse, and above Ayer the river was considerably more polluted than was the case last year. Below Ayer, though the river receives the large quantity of effluent discharged through the sewage disposal works at Camp Devens, its condition was less objectionable than in the previous year.

At Camp Devens, in Ayer, the sewage disposal system, completed soon after the camp was occupied, has been in operation during the past year. The sewage is pumped to filter beds, 20 acres in area, located on high gravelly land in the northwesterly part of the town. The material of the filters is of excellent quality for the purpose, and beneath a deep layer of sand, strata of very coarse material are found, so that it was deemed unnecessary to provide underdrainage for the filters. The large quantity of sewage disposed of on this area sinks into the ground and doubtless finds its way to neighboring water courses, though no considerable outflow of effluent has been found at any point. The rate of operation has been higher than usual for sand filters, but the results of their operation have been excellent.

The most offensive pollution of the Nashua River or any of its tributaries is that which is caused by the sewage of the city of Leominster, which is discharged untreated into the streams near the city. During the year an experimental sewage disposal works was constructed at Leominster for the treatment of the sewage from a small area in the city, the quantity of sewage treated amounting apparently to about 75,000 gallons per day. The works consist of duplicate septic tanks, contact beds and trickling filters, the latter provided with a

limited amount of underdrainage for such filters. The trickling filters are each about one-sixth of an acre in area, only one having been used thus far. With one unit in use, the rate of operation of the trickling filter is only about one-third the rate at which trickling filters are usually operated with satisfactory results. When examined, the distribution upon the trickling filter was unsatisfactory, the effluent of very poor quality, and the odor about the works offensive. The results of the experiment thus far indicate that the treatment of the entire sewage of Leominster by works of this character would be inefficient and impracticable. Far better results could be obtained at less expense by the method already recommended. It is important for the protection of the public health in the Nashua River valley that the sewage of the city of Leominster shall be given proper treatment before it is discharged into the river, and the construction of suitable works should be begun without further delay.

Sewerage of the City of Worcester.

Experiments upon the treatment of the sewage of the city of Worcester by the activated sludge process, so called, were carried on from July 7, 1917, to Aug. 20, 1918, when the work was discontinued. The results of these experiments have not yet been summarized completely, but so far as available they indicate that, while the sewage of the city of Worcester could be treated successfully by this process, it would probably be a more difficult and expensive one to adopt than the method of disposal by trickling filters without any material offsetting advantages. The city is now in a position to proceed with the construction of new disposal works, plans for which are already being prepared. There appears to be nothing to prevent the carrying on of this work to completion without further study than is required in the preparation of suitable plans, though it is possible that legislation may be necessary to enable the city to obtain the funds required.

Sewerage in the Taunton River Valley.

Improvements in the sewerage works at Brockton have been carried on slowly during the year. New pumping machinery is being installed, and its capacity will soon be sufficient to pump all of the sewage to the disposal works and prevent further overflow into the Salisbury Plain River. Experiments are under way to determine the best practicable plan of enlarging the sewage disposal works and improving the character of the effluent in preparation for the construction of additional works as

soon as practicable. The revolving screen at the pumping station was abandoned in June, and the sewage is now applied to the trickling filter and the sand filters without preliminary treatment.

The town of Bridgewater is temporarily discharging its sewage into the Town River, but has prepared plans for works for the treatment of the sewage the construction of which has been postponed on account of the war.

The town of Middleborough prepared plans for the treatment of the sewage of that town many years ago, but has taken no further action in the matter.

The city of Taunton, acting through its sewer commissioners, began early in 1917 the preparation of plans of works for the treatment of its sewage, but owing to the lack of engineers on account of the war the work was discontinued. The cause of this delay being removed, it is expected that the work will be taken up again and carried to completion.

Sewage Disposal Systems.

The following is a list of the principal sewage disposal works now in operation in the State: —

Amherst.
Andover.
Attleboro.
Ayer (Camp Devens).
Billerica.
Brockton.
Clinton.
Concord.
Easthampton.
Fitchburg.
Framingham.
Franklin.
Gardner.
Hopedale.
Hudson.
Leicester
Lenox.
Longmeadow.
Marion.
Marlborough.
Maynard.
Medfield.
Milford.
Natick.
North Attleborough.
North Brookfield.
Northbridge.
Norwood.
Pittsfield.
Southbridge.
Spencer.
Stockbridge
Westborough.
Worcester.

Practically no work has been done in the enlargement or improvement of sewage disposal systems during the year 1918 on account of conditions brought about by the war. In consequence of these conditions, the additional filters which were under construction at Andover and Stockbridge in 1917 have not yet been completed, and the improve-

ments so essential to proper sewage disposal at Southbridge have not been begun. The extension of the Easthampton sewer outlet to the Connecticut River has also been postponed, together with the necessary improvements at Brockton, Milford and a number of other places. A decided improvement in the maintenance and operation of the filters at Framingham has greatly increased the efficiency of that works, notwithstanding the fact that the quantity of sewage was materially increased during the past year by the encampment of a large number of sailors at the old muster field. The sewage disposal works at Marlborough continue to give satisfactory results, and excellent results are also being obtained at Attleboro, Franklin, Hudson and many of the other places in the list.

A number of works are now greatly overtaxed, and additions and extensions are badly needed. Chief among these are the works at Southbridge, Natick, Northbridge, Milford and Andover. At Clinton the amount and character of the sewage are such as to overtax considerably the filter beds at the present time. It is probable that by reducing the amount of ground water entering the sewers, and by the treatment of the manufacturing wastes of the Bigelow Carpet Company (which contain an excessive quantity of fats) now discharged into the sewers, the works could be relieved of much of the load now discharged upon them and the efficiency of the treatment made satisfactory.

At some of the other works, particularly at Gardner and at Leicester, considerable quantities of sewage are discharged directly into the streams on account of the works being of inadequate capacity.

At Pittsfield sewage has been discharged from time to time into the Housatonic River, though the sewage disposal works in this case are probably adequate at present for the disposal of all of the sewage of the city.

At Northbridge the underdrainage system has been reconstructed and the beds resurfaced.

At Norwood additional filters previously laid out were completed during the year, and at Marion the filters were resurfaced.

Results of Examinations of Sewage and Effluent at Various Sewage Disposal Works, 1918.

The average results of the analyses of sewage and effluent, together with statistics concerning the more important sewage disposal works in the State, are presented in the following tables: —

TABLE No. 1. — *Average Results of the Analyses of Monthly Samples of Sewage as received at the Disposal Works (Fats determined in about 69 Per Cent of the Samples).*

[Parts in 100,000.]

City or Town.	Residue on Evaporation.						Ammonia.				Chlorine.	Oxygen consumed.		Iron.		Kjeldahl Nitrogen.	Fats.
	Total residue.			Loss on ignition.			Free.	Albuminoid.									
	Total.	Dissolved.	Suspended.	Total.	Dissolved.	Suspended.		Total.	Dissolved.	Suspended.		Unfiltered.	Filtered.	Unfiltered.	Filtered.		
Andover,	50.87	36.28	14.59	28.07	16.85	11.22	3.69	.87	.47	.40	7.11	5.70	3.27	.162	.071	1.49	8.01
Attleboro,[1]	28.64	21.88	6.76	12.28	7.84	4.44	2.69	.41	.20	.21	4.56	2.72	1.30	.142	.072	.74	–
Brockton,	90.90	59.73	31.17	51.82	23.80	28.02	7.54	1.72	.80	.92	13.14	12.95	7.76	.314	.123	2.92	12.82
Clinton,	152.96	82.38	70.58	101.67	40.00	61.67	5.20	2.20	1.08	1.12	7.59	18.45	9.37	.729	.315	3.86	54.63
Concord,[2]	35.86	27.16	8.70	19.13	12.63	6.50	2.05	.49	.29	.20	4.87	3.76	2.53	–	–	.95	–
Easthampton,[2]	53.73	36.73	17.00	28.83	16.00	12.83	4.21	1.03	.58	.45	5.16	5.80	3.07	.235	.105	1.53	–
Fitchburg,	53.10	32.18	20.92	23.92	13.52	10.40	2.14	.76	.45	.31	6.68	5.52	3.35	.889	.247	1.31	5.80
Framingham,	125.12	82.94	42.18	56.08	24.00	32.08	4.40	1.51	.85	.66	26.02	9.41	4.53	.346	.090	2.31	13.64
Franklin,[2]	42.43	27.07	15.36	21.80	12.13	9.67	2.73	1.14	.55	.59	3.46	5.43	2.46	–	–	1.42	–
Gardner (Gardner area),[3]	96.55	54.00	42.55	59.90	25.45	34.45	13.35	2.75	1.54	1.21	9.69	12.00	6.10	.260	.051	4.47	12.26
Gardner (Templeton area),	72.65	49.36	23.29	39.06	20.71	18.35	7.74	1.71	1.08	.63	10.17	7.18	3.92	.195	.049	3.05	8.14
Hopedale,[2]	52.90	37.23	15.67	32.83	20.10	12.73	7.32	1.54	.79	.75	6.88	7.13	4.02	–	–	2.13	–
Hudson,	138.67	113.75	24.92	42.57	25.05	17.52	6.30	1.62	.97	.65	44.83	9.33	5.28	.213	.077	2.88	8.65
Leicester,[3]	38.50	31.85	6.65	19.45	13.80	5.65	3.24	.64	.39	.25	5.31	2.98	2.06	.142	.041	.97	–
Marion,[4]	41.27	28.03	13.24	21.07	9.80	11.27	2.38	.57	.33	.24	7.30	3.59	1.88	.298	.068	.88	–
Marlborough,	70.98	45.48	25.50	37.92	17.66	20.26	4.81	1.28	.63	.65	9.69	8.21	4.02	.427	.127	2.31	10.20
Milford,	72.98	53.35	19.63	39.51	23.68	15.83	4.53	1.35	.86	.49	9.50	8.46	4.24	.184	.057	2.28	–
Natick,	51.45	41.75	9.70	21.30	14.74	6.56	3.14	.73	.42	.31	8.64	3.75	2.32	.273	.053	1.12	4.60
North Attleborough,[2]	32.17	25.17	7.00	13.93	9.60	4.33	1.38	.56	.26	.30	6.21	2.69	1.25	.140	.067	1.00	–
Northbridge,[2]	38.33	25.02	13.31	24.56	13.20	11.36	3.90	.98	.53	.45	3.73	4.22	2.43	–	–	1.47	–
Norwood,	108.68	88.64	20.04	35.68	23.04	12.64	4.44	.93	.43	.50	33.75	9.63	5.27	.285	.080	1.66	7.57
Pittsfield,	39.04	32.90	6.14	19.78	15.44	4.34	2.61	.57	.35	.22	4.64	3.36	2.12	.108	.050	1.02	3.06
Southbridge,[1]	51.12	34.76	16.36	26.76	15.16	11.60	4.14	.98	.54	.44	7.54	4.88	3.00	.294	.086	1.90	–
Spencer,[2]	37.80	27.77	10.03	21.07	13.10	7.97	3.78	.87	.45	.42	4.44	4.25	2.91	.192	.063	1.19	2.74
Stockbridge,[5]	24.40	21.47	2.93	10.13	8.07	2.06	1.11	.24	.14	.10	1.58	1.69	1.06	–	–	.38	–
Westborough,	56.63	43.17	13.46	30.12	20.37	9.75	2.80	.98	.58	.40	6.11	5.93	3.69	.382	.075	1.67	6.21
Worcester (day),[5]	118.00	76.47	41.53	46.47	18.13	28.34	3.04	1.77	.60	1.17	15.67	12.40	4.43	4.107	.393	–	–
Worcester (night),[1]	106.85	66.73	40.12	45.88	17.78	28.10	1.95	.95	.32	.63	11.88	11.35	4.34	5.900	2.875	1.97	–

[1] Five samples. [2] Every other month. [3] Four samples. [4] Six samples. May to October, inclusive. [5] Three samples.

TABLE No. 2. — *Average Results of the Analyses of Monthly Samples of Sewage as applied to Filter Beds after Preliminary Treatment as indicated (Fats determined in about 69 Per Cent of the Samples).*

[Parts in 100,000.]

City or Town.	Form of Preliminary Treatment.	Residue on Evaporation.						Ammonia.				Chlorine.	Oxygen consumed.		Iron.		Kjeldahl Nitrogen.	Fats.
		Total residue.			Loss on ignition.			Free.	Albuminoid.									
		Total.	Dissolved.	Suspended.	Total.	Dissolved.	Suspended.		Total.	Dissolved.	Suspended.		Unfiltered.	Filtered.	Unfiltered.	Filtered.		
Andover,	Tank,	53.73	40.88	12.85	27.07	16.22	10.85	4.07	.88	.54	.34	7.76	5.85	3.64	.157	.082	1.67	7.16
Attleboro,[1]	None,	28.64	21.88	6.76	12.28	7.84	4.44	2.69	.41	.20	.21	4.56	2.72	1.30	.142	.072	.74	–
Brockton,	Revolving screen,[2]	90.90	59.73	31.17	51.82	23.80	28.02	7.54	1.72	.80	.92	13.14	12.95	7.76	.314	.123	2.92	12.82
Clinton,	Basins,	64.27	52.64	11.63	30.75	23.12	7.63	3.45	.92	.62	.30	5.74	6.67	5.22	.735	.429	1.75	11.74
Concord,[3]	None,	35.86	27.16	8.70	19.13	12.63	6.50	2.05	.49	.29	.20	4.87	3.76	2.53	–	–	.95	–
Easthampton,[3]	Tanks,	50.43	37.20	13.23	28.30	17.53	10.77	4.22	.88	.50	.38	5.51	5.17	2.72	.225	.086	1.40	–
Fitchburg,	Imhoff tanks,	38.33	32.45	5.88	15.62	13.03	2.59	2.59	.51	.33	.18	6.68	3.45	2.55	.490	.249	.86	3.04
Framingham,	None,	125.12	82.94	42.18	56.08	24.00	32.08	4.40	1.51	.85	.66	26.02	9.41	4.53	.346	.090	2.31	13.64
Franklin,[2]	Tanks,	27.47	23.97	3.50	11.70	8.83	2.87	2.10	.38	.28	.10	4.06	1.84	1.48	–	–	.65	–
Gardner[4] (Gardner area),	None,	96.55	54.00	42.55	59.90	25.45	34.45	13.35	2.75	1.54	1.21	9.69	12.00	6.10	.260	.051	4.47	12.26
Gardner (Templeton area),	Tanks,	43.71	38.03	5.68	17.82	15.08	2.74	3.97	.55	.43	.12	9.46	3.59	2.84	.120	.078	.94	3.60
Hopedale,[3]	Tanks,	34.57	27.86	6.71	19.47	14.23	5.24	4.84	.79	.47	.32	4.68	3.71	2.34	–	–	1.04	–
Hudson,	Tanks,	78.56	69.73	8.83	23.88	19.10	4.78	5.60	.74	.45	.29	24.51	4.33	2.95	.104	.048	1.22	4.00
Leicester,[4]	None,	38.50	31.85	6.65	19.45	13.80	5.65	3.24	.64	.39	.25	5.31	2.98	2.06	.142	.041	.97	–
Marion,[5]	None,	41.27	28.03	13.24	21.07	9.80	11.27	2.38	.57	.33	.24	7.30	3.59	1.88	.298	.068	.88	–
Marlborough,	Tanks,	53.38	43.42	9.96	23.65	17.72	5.93	3.70	.74	.48	.26	9.86	4.92	3.19	.569	.248	1.32	4.89
Milford,	Tanks,	52.17	41.98	10.19	23.42	15.61	7.81	4.34	.86	.49	.37	8.38	4.85	3.30	.194	.081	1.35	–
Natick,	None,	51.45	41.75	9.70	21.30	14.74	6.56	3.14	.73	.42	.31	8.64	3.75	2.32	.273	.053	1.12	4.60
North Attleborough,[3]	Tanks,	26.83	21.60	5.23	9.40	6.23	3.17	1.22	.23	.15	.08	5.95	1.26	.86	.216	.070	.43	–
Northbridge,[3]	Tanks,	16.01	13.28	2.73	6.83	4.58	2.25	1.58	.34	.20	.14	2.38	1.63	1.06	–	–	.66	–
Norwood,	Tank,	83.18	68.50	14.68	29.58	19.60	9.98	3.25	.67	.31	.36	24.09	7.01	4.49	.256	.108	1.40	4.53
Pittsfield,	None,	39.04	32.90	6.14	19.78	15.44	4.34	2.61	.57	.35	.22	4.64	3.36	2.12	.108	.050	1.02	3.06
Southbridge,[1]	Tanks,	33.36	27.92	5.44	15.84	12.28	3.56	3.45	.57	.41	.16	5.78	3.07	1.87	.202	.128	.93	–
Spencer,[3]	None,	37.80	27.77	10.03	21.07	13.10	7.97	3.78	.87	.45	.42	4.44	4.25	2.91	.192	.063	1.19	2.74
Stockbridge,[6]	None,	24.40	21.47	2.93	10.13	8.07	2.06	1.11	.24	.14	.10	1.58	1.69	1.06	–	–	.38	–
Westborough,	None,	56.63	43.17	13.46	30.12	20.37	9.75	2.80	.98	.58	.40	6.11	5.93	3.69	.382	.075	1.67	6.21
Worcester[6] (day),	Tanks,	118.00	76.47	41.53	46.47	18.13	28.34	3.04	1.77	.60	1.17	15.67	12.40	4.43	4.107	.393	–	–

[1] Five samples.
[2] Sewage as received at pumping station. Screen abandoned in June. Not in satisfactory operation early part of year.
[3] Every other month.
[4] Four samples.
[5] Six samples. May to October, inclusive.
[6] Three samples.

TABLE No. 3. — *Efficiency of Settling Tanks and Other Forms of Preliminary Treatment as indicated by the Foregoing Tables.*

[Parts in 100,000.]

City or Town.	Form of Preliminary Treatment.	Suspended Solids.			Total Albuminoid Ammonia.			Oxygen consumed.			Fats.[1]			Chlorine.		Approximate Period of Sedimentation, assuming Tanks contain no Deposits (Hours).	Frequency of Cleaning Tanks during Year.
		Raw Sewage.	Settled or Treated Sewage.	Per Cent removed.	Raw Sewage.	Settled or Treated Sewage.	Per Cent removed.	Raw Sewage.	Settled or Treated Sewage.	Per Cent removed.	Raw Sewage.	Settled or Treated Sewage.	Per Cent removed.	Raw Sewage.	Settled or Treated Sewage.		
Andover,	Tank,	14.59	12.85	12	.87	.88	–	5.70	5.85	–	8.01	7.16	11	7.11	7.76	¾–2½	Ten days to two weeks.
Clinton,	Basins,	70.58	11.63	84	2.20	.92	58	18.45	6.67	64	54.63	11.74	79	7.59	5.74	4–6	About once per month.
Easthampton,	Tanks,	17.00	13.23	22	1.03	.88	15	5.80	5.17	11	–	–	–	5.16	5.51	4–5	Four days to two months.
Fitchburg,	Imhoff tanks,[2]	20.92	5.88	72	.76	.51	33	5.52	3.45	38	5.80	3.04	48	6.68	6.68	5½–11½	As often as sludge beds would allow.
Franklin,	Tanks,	15.36	3.50	77	1.14	.38	67	5.43	1.84	66	–	–	–	3.46	4.06	5½–6½	Fifteen times.
Gardner (Templeton area).	Tanks,	23.29	5.68	77	1.71	.55	68	7.18	3.59	50	8.14	3.60	56	10.17	9.46	6¼–8½	First tank each month, others two to six months.
Hopedale,	Tanks,	15.67	6.71	57	1.54	.79	49	7.13	3.71	48	–	–	–	6.88	4.68	20–30	Once.
Hudson,	Tanks,	24.92	8.83	65	1.62	.74	54	9.33	4.33	54	8.65	4.00	54	44.83	24.51	14–27	Once.
Marlborough,	Tanks,	25.50	9.96	61	1.28	.74	42	8.21	4.92	40	10.20	4.89	52	9.69	9.86	–[3]	Twelve times.
Milford,	Tanks,	19.63	10.19	48	1.35	.86	36	8.46	4.85	43	–	–	–	9.50	8.38	2½–3½	Three to four times.
North Attleborough,	Tanks,	7.00	5.23	25	.56	.23	59	2.69	1.26	53	–	–	–	6.21	5.95	2¾–3¾	Once.
Northbridge,	Tanks,	13.31	2.73	80	.98	.34	65	4.22	1.63	61	–	–	–	3.73	2.38	3¾–4¼	Once in two to four weeks.
Norwood,	Tank,	20.04	14.68	27	.93	.67	28	9.63	7.01	27	7.57	4.53	40	33.75	24.09	1¼–2¼	Six times.
Southbridge,	Tanks,	16.36	5.44	67	.98	.57	42	4.88	3.07	37	–	–	–	7.54	5.78	1¾–7¼	Ten times.
Worcester,	Chemical precipitation.	40.12	10.76	73	.95	.50	47	11.35	4.30	62	–	–	–	11.88	8.21	4–5	– – –

[1] Fats determined in about two-thirds of the samples.

[2] Five tanks. Flow reversed three times.

[3] Several compartments. Operated so as to get good sedimentation, but not to produce a septic effluent.

TABLE No. 4. — *Average Results of the Analyses of Monthly Samples of Sewage applied to the Trickling Filters at Brockton and Fitchburg, and of their Effluents, etc. Per Cents removed, etc.*

Brockton.

[Parts in 100,000.]

	Residue on Evaporation.						Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.		Kjeldahl Nitrogen.	Fats.	Remarks.
	Total residue.			Loss on ignition.			Free.	Albuminoid.										
	Total.	Dissolved.	Suspended.	Total.	Dissolved.	Suspended.		Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	Unfiltered.	Filtered.			
Screened sewage as applied to trickling filter.	57.74	42.68	15.06	30.94	18.72	12.22	5.63	1.09	.51	.58	9.80	–	–	7.44	3.87	2.06	5.52	The trickling filter has an area of .5 of an acre and a depth of 5.5 to 6.5 feet of crushed stone from 1.5 to 3 inches in size. The average rate of operation was 950,000 gallons per acre per day.
Effluent from trickling filter,	53.40	41.87	11.53	24.60	15.78	8.82	3.59	.89	.44	.45	9.88	1.0844	.0281	5.18	2.59	1.45	2.75	
Per cent removed,	8	–	23	20	–	28	36	18	–	22	–	–	–	30	33	30	50	
Settled effluent from trickling filter as applied to sand filters.	46 64	40.44	6.20	17.71	13.40	4.31	3.60	.63	.36	.27	10.70	.6944	.0188	4.14	2.82	1.02	1.93	
Per cent removed by tank,	13	–	46	28	–	51	–	29	–	40	–	–	–	20	–	30	30	
Per cent removed by trickling filter and settling tank.	19	–	59	43	–	65	36	42	–	53	–	–	–	44	27	50	65	

TABLE NO. 4. — *Average Results of the Analyses of Monthly Samples of Sewage applied to the Trickling Filters at Brockton and Fitchburg, and of their Effluents, etc. Per Cents removed, etc.* — Concluded.

Fitchburg.

[Parts in 100,000.]

	Residue on Evaporation.						Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.		Kjeldahl Nitrogen.	Fats.	Remarks.
	Total residue.			Loss on ignition.				Albuminoid.										
	Total.	Dissolved.	Suspended.	Total.	Dissolved.	Suspended.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	Unfiltered.	Filtered.			
Imhoff tank effluent as applied to trickling filter.	38.33	32.45	5.88	15.62	13.03	2.59	2.59	.51	.33	.18	6.68	–	–	3.45	2.55	.86	3.04	The trickling filter has an area of 2.14 acres and a depth of 10 feet of stone from 1 to 3 inches in size. The average rate of operation was about 1,290,000 gallons per acre per day.
Effluent from trickling filter,	36.67	29.65	7.02	16.02	11.71	4.31	.74	.30	.13	.17	6.74	1.3012	.0166	1.91	1.08	.50	1.33	
Per cent removed, . .	4	–	–	–	–	–	71	41	–	6	–	–	–	45	58	42	56	
Settled effluent from trickling filter as discharged to Nashua River.	34.38	30.25	4.13	14.03	11.42	2.61	.54	.20	.12	.08	6.84	1.2498	.0177	1.42	1.10	–	1.00	Period of sedimentation averaged about two and three-quarters hours. The tanks were cleaned six times from May to November.
Per cent removed by tanks,	6	–	41	12	–	39	27	33	–	53	–	–	–	26	–	–	25	
Per cent removed by trickling filter and settling tanks.	10	–	30	10	–	–	79	61	–	56	–	–	–	59	57	–	67	

TABLE NO. 5. — *Average Results of the Analyses of Monthly Samples of Effluent from Sand Filters.*

[Parts in 100,000.]

CITY OR TOWN.	Free Ammonia.	Total Albuminoid Ammonia.	Chlorine.	NITROGEN AS —		Iron.
				Nitrates.	Nitrites.	
Andover,[1]	1.94	.1752	8.97	.6723	.0176	.404
BROCKTON,	4.17	.1489	10.69	.1894	.0048	1.643
BROCKTON (sand filters used for settled trickling filter effluent).	2.26	.1329	12.03	.6782	.0047	1.104
Clinton,[1]	1.62	.1142	5.38	.2573	.0022	1.929
Concord,[2]	.44	.0308	4.25	.7758	.0062	.036
Easthampton,[2]	.30	.0678	4.89	1.5847	.0590	.083
Framingham,[1]	1.97	.1363	12.19	1.2916	.0290	1.211
Franklin,[2]	.89	.0567	3.63	1.1383	.0029	.066
Gardner (Gardner Area),[3]	2.56	.1400	7.95	3.8275	.0088	.098
Gardner (Templeton Area),[1]	2.68	.2990	11.44	1.9944	.0309	.077
Hopedale,[2]	1.48	.1508	4.57	2.2878	.0079	.026
Hudson,	1.21	.1324	25.45	1.6671	.0169	.257
Leicester,[3]	1.51	.2195	4.49	.1698	.0132	.555
Marion,[4]	.53	.0687	5.87	.7835	.0027	.074
MARLBOROUGH,[1]	1.37	.0806	8.31	2.1111	.0054	.102
Milford,	1.45	.1028	7.46	.8358	.0086	.513
Natick,	2.35	.0971	7.95	.2520	.0079	1.160
North Attleborough,[2]	.09	.0135	3.93	.7885	.0019	.008
Northbridge,	.92	.0877	3.19	.5316	.0120	.382
Norwood,	1.31	.0760	18.89	.3070	.0106	.546
PITTSFIELD,[4]	.82	.1054	4.09	.6786	.0136	.190
Southbridge,[5]	1.06	.0877	4.78	.8754	.0102	.595
Spencer,	.17	.0362	3.90	.9358	.0006	.017
Stockbridge,[6]	.22	.0610	3.04	.8544	.0049	.169
Westborough,[1]	.73	.1195	5.15	.7331	.0191	.404
WORCESTER,[7]	2.05	.1493	14.22	.9180	.0133	1.267

[1] Regular samples from two or more underdrains combined in one average.
[2] Every other month.
[3] Four samples.
[4] Several underdrains. December to February, inclusive, omitted.
[5] Several underdrains. Five months.
[6] Two samples from underdrains of sand beds and three from irrigation area.
[7] January, July and September.
NOTE. — Very little effluent has as yet appeared in underdrains at Attleboro. Concord effluent samples taken from spring.

TABLE NO. 6. — *Efficiency of Sand Filters (Per Cent of Free and Albuminoid Ammonia removed).*

[Parts in 100,000.]

CITY OR TOWN.	FREE AMMONIA.			TOTAL ALBUMINOID AMMONIA.			CHLORINE.		Rate of Operation with Even Distribution (Gallons per Acre per Day).[1]
	Applied Sewage.	Effluent.	Per Cent removed.	Applied Sewage.	Effluent.	Per Cent removed.	Applied Sewage.	Effluent.	
Andover,	4.07	1.94	52	.88	.18	80	7.76	8.97	60,000
BROCKTON,	7.54	4.17	45	1.72	.15	91	13.14	10.69	62,000
BROCKTON (filters for settled trickling filter effluent).	3.60	2.26	37	.63	.13	79	10.70	12.03	68,000
Clinton,	3.45	1.62	53	.92	.11	88	5.74	5.38	41,000
Concord,[2]	2.05	.44	79	.49	.03	94	4.87	4.25	107,000
Easthampton,	4.22	.30	93	.88	.07	92	5.51	4.89	–
Framingham,	4.40	1.97	55	1.51	.14	91	26.02	12.19	44,000
Franklin,	2.10	.89	58	.38	.06	84	4.06	3.63	53,000
Gardner (Gardner area),[3]	13.35	2.56	81	2.75	.14	95	9.69	7.95	–
Gardner (Templeton area),	3.97	2.68	32	.55	.30	45	9.46	11.44	67,000
Hopedale,	4.84	1.48	69	.79	.15	81	4.68	4.57	29,000
Hudson,	5.60	1.21	78	.74	.13	82	24.51	25.15	35,000
Leicester,	3.24	1.51	53	.64	.22	66	5.31	4.49	–
Marion,	2.38	.53	78	.57	.07	88	7.30	5.87	100,000
MARLBOROUGH,	3.70	1.37	63	.74	.08	89	9.86	8.31	42,000
Milford,	4.34	1.45	67	.86	.10	88	8.38	7.46	73,000
Natick,	3.14	2.35	25	.73	.10	86	8.64	7.95	65,000
North Attleborough,	1.22	.09	93	.23	.01	96	5.95	3.93	103,000
Northbridge,	1.58	.92	42	.34	.09	74	2.38	3.19	83,000
Norwood,	3.25	1.31	60	.67	.08	88	24.09	18.89	95,000
PITTSFIELD,	2.61	.82	69	.57	.11	81	4.64	4.09	81,000
Southbridge,	3.45	1.06	69	.57	.09	84	5.78	4.78	115,000
Spencer,	3.78	.17	96	.87	.04	95	4.44	3.90	48,000
Stockbridge,	1.11	.22	80	.24	.06	75	1.58	3.04	–
Westborough,	2.80	.73	74	.98	.12	88	6.11	5.15	67,000
WORCESTER,	3.04	2.05	33	1.77	.15	92	15.67	14.22	67,000

[1] See also Table No. 7.

[2] See note at foot of Table No. 5.

[3] These filters given long periods of rest from time to time.

TABLE No. 7. — *Extent of Sewerage Works, Rate of Flow and Rate of Operation of Sand Filters, etc.*

CITY OR TOWN.	Population, Census of 1915.	Approximate Length of Sanitary Sewers (Miles).	Approximate Number of House Connections.	ESTIMATED QUANTITY OF SEWAGE TREATED (GALLONS PER DAY).			Estimated Average Quantity of Sewage per Connection (Gallons per Day).	Net Area of Filter Beds (Acres).	Estimated Rate of Operation with Even Distribution (Gallons per Acre per Day).
				Average for Year.	Average for Month of Maximum Flow.	Average for Month of Minimum Flow.			
Andover,	7,978	12.69	833	219,000	254,000	171,000	260	3.65[1]	60,000
ATTLEBORO,	18,480	30.86	1,027	553,000	741,000	404,000	540	15.50	36,000
BROCKTON,	62,288	83.09	6,188	1,845,000[2]	2,324,000	1,336,000	370	30.00	62,000
Clinton,	13,192	21.00	1,525	475,000[2]	808,000	–		7.00	68,000
				1,066,000[2]	1,437,000	872,000	700	26.23	41,000
Concord,	6,681	8.69	461	460,000[2]	743,000	310,000	1,000	4.28	107,000
Easthampton,	9,845	24.00	1,160	500,000	–	–	430	2.20	–
FITCHBURG,	39,656	–	–	2,757,000	4,109,000	1,963,000	–	–	–
Framingham,	15,860	25.75	2,279	934,000[2]	1,100,000	777,000	410	21.12	44,000
Franklin,	6,440	11.27	302	173,000	297,000	81,000	570	3.24	53,000
Gardner,	16,376	28.07	1,783	900,000	–	–	500	12.50[3]	72,000
Hopedale,	2,663	–	–	110,000[2]	–	–	–	3.79	29,000
Hudson,	6,758	9.69	624	317,000[2]	377,000	277,000	510	9.00	35,000
Leicester,	3,322	–	–	–	–	–	–	.36	–
Marion,	1,487	3.91	152	75,000[2]	–	–	490	.75	100,000
MARLBOROUGH,	15,250	29.05	2,063	870,000	1,532,000	429,000	420	20.90	42,000
Milford,	13,684	17.53	1,213	681,000	808,000	622,000	560	9.30	73,000
Natick,	11,119	–	–	822,000[2]	1,183,000	527,000	–	12.60	65,000
North Attleborough,	9,398	16.19	527	719,000[2]	800,000	626,000	1,360	7.00	103,000
Northbridge,	9,254	–	–	496,000	544,000	457,000	–	6.00	83,000
Norwood,	10,977	–	–	1,000,000	–	–	–	10.54	95,000
PITTSFIELD,	39,607	–	–	3,313,000[2]	3,858,000	–	–	41.15	81,000
Southbridge,	14,217	–	1,089	980,000	1,350,000	790,000	900	8.50	115,000
Spencer,	5,994	–	–	450,000	–	–	–	9.30	48,000
Westborough,	5,925	9.60	552	388,000	540,000	281,000	700	5.80	67,000
WORCESTER,	162,697	181.55[4]	–	4,890,000[5]	–	–	–	72.60	67,000

[1] A sludge bed with an area of .12 of an acre, and four filter beds with an aggregate area of .37 of an acre under construction.

[2] From pumping records.

[3] Gardner area, 2.50 acres. Templeton area, 10 acres.

[4] Includes 69.58 miles of combined sewers.

[5] Amount treated by sand filters. Total flow, 18,119,000 gallons per day.

Table No. 8. — *General Features.*

[For data concerning the trickling filters at Brockton and Fitchburg see Table No. 4.]

City or Town.	Year of Construction of and Additions to Works.	Depth of Underdrains (Feet).	Distance Apart of Underdrains (Feet).	Filtering Material.	Attention given to Disposal Works.
Andover,	1898	4	20	Fair sand, small quantity of gravel; practically all handled in construction.	One man all the time.
Attleboro,	1912, 1913	4-7	35	Excellent sand and gravel; found in place,	One man all the time; others when necessary.
Brockton,	1893, 1905 1908, 1912	5.5	30	Good sand and gravel; found in place,	Four men all the time; large force when necessary.
Clinton,	1898, 1899	8	60–70	Good sand and gravel; found in place,	Two men all the time; others when necessary.
Concord,	1899	none	–	Good sand underlaid with gravel; found in place,	One man once a day.
Easthampton,	1908	3.5	20–40	Good sand and gravel; largely found in place,	One man all the time; one other when necessary.
Framingham,	1890	4–4.5	30–40	Good sand and gravel,	Three or more men in summer; only one in winter.
Franklin,	1915	4.5	26	Good sand and gravel,	One man every two or three days; others when necessary.
Gardner (Gardner area),	1891	5	20	Good sand; handled in construction,	One man all the time.
Gardner (Templeton area),	1901, 1909	3–4	20–30	Coarse sand; handled in construction,	One man all the time; more when necessary.
Hopedale,	1900	3	35–60	Some good sand and some rather fine sand,	One man all the time.
Hudson,	1904, 1910	5–6	50–100	Good sand and gravel; found in place,	One man all the time; others when necessary.
Leicester,	1894	4	8	Hard, compact sand; found in place,	Very little attention.
Marion,	1906	5	–	Mostly good sand; pockets of fine sand and some ledge; largely found in place.	One man every day in summer; every other day in winter.
Marlborough,	1891, 1908 1909,1910,1911	4.5–6	30–50	Rather fine sand; found in place,	One man all the time; others when necessary.
Milford,	1907	5	40	Rather fine sand; found in place,	One man every day; others when necessary.
Natick,	1896	6	36	Sand of good quality, but strata of very fine sand in places; found in place.	One man all the time; others when necessary.
North Attleborough,	1909, 1910	5–6.5	55	Coarse sand and gravel; largely found in place,	One man every day; others when necessary.
Northbridge,	1906, 1907	4	50–75	Coarse sand and gravel; mostly handled,	One man all the time; others when necessary.
Norwood,	1909	4–6	40	Good sand and gravel; found in place,	One man every day; others when necessary.
Pittsfield,	1901, 1915	4	35	Good sand; mostly found in place,	Two men all the time; others when necessary.
Southbridge,	1908	4	40	Fair sand and gravel; considerable quantity handled, some found in place.	One man once a day.
Spencer,	1897	–[1]	–	Good sand and gravel; largely found in place,	One man all the time; others when necessary.
Stockbridge,	1899	3–4.5	23	Sand filters, good quality sand,	One man all the time.
		3–4.5	30	Irrigation area, rather fine sand,	
Westborough,	1892, 1911	5	30–40	Good sand and gravel; handled in construction,	One man all the time; others when necessary.
Worcester,	1898[2]	4–6	35–50	Good sand and gravel; largely found in place,	Several men all the time; a large force when necessary.

[1] Only 3 beds underdrained.

[2] Year of first construction of sand filters. Many additions.

Examination of Rivers.

In general, the pollution of the rivers of the State has increased in 1918 as compared with the previous year, and their condition in some cases has been more objectionable than for several years. A brief statement of the condition of the various rivers at the more important points is here presented: —

Aberjona River and Mystic Lakes.

The condition of the Aberjona River was satisfactory throughout the warmer part of the year, but late in the year there was an increase of organic matter in the stream, and the average quantity of organic matter in the water during the year has been somewhat greater at the entrance to Mystic Lake than in the previous year. The amount of acid present in the water, however, has been low.

By the provisions of chapter 34 of the Resolves of the year 1918 the Department was directed to ascertain the cost of constructing a sewer or sewers adequate for the disposal of the sewage and manufacturing waste now discharged into the Mystic Lakes in the towns of Arlington and Winchester and the city of Medford. It has been impracticable to complete this work during the past year, and a request has been made for an extension of time for carrying out this work.

Assabet River.

The condition of the Assabet River has shown but little change at any point during the past year as compared with the previous year. The river is still very badly polluted below Maynard, though its condition is somewhat less objectionable than was the case a few years ago.

Blackstone River.

The condition of the Blackstone River has shown no very material change in the past few years. When examined in the summer of 1918 the appearance of the stream was objectionable and its odor offensive throughout a large part of its course below Worcester.

Charles River.

The pollution of the Charles River has increased in 1918 throughout most of its course, but especially in the upper reaches in Medway and Medfield. The pollution of Mine Brook, one of its principal tributaries, has increased decidedly above the Franklin filter beds, and, though its

condition below the filters is much better, it still shows the effect of the pollution above. The pollution of this stream is largely due to manufacturing waste.

Chicopee River.

The condition of the Chicopee River has shown little change in the past year as compared with the previous year, and while this river receives considerable pollution it is not objectionable at the present time. Of its principal tributaries, the Quaboag, Ware and Swift rivers, the latter receives very little pollution of any kind except that which is caused by manufacturing waste discharged into the river in the lower portion of its course near its confluence with the Ware and Quaboag, which causes no seriously objectionable condition at the present time. The principal pollution of the Quaboag River is that which is caused by the sewage of Palmer, but the quantity of sewage discharged into the river up to the present time has not been sufficient to render it unsightly or seriously objectionable in any part of its course. The Ware River, on the other hand, is polluted by manufacturing wastes at several points along its course, and is seriously polluted below Ware by manufacturing waste and especially by the discharge from the sewers of the town.

The maintenance of proper sanitary conditions in this stream is likely soon to require the establishment of disposal works for treating the sewage of the town of Ware and the more objectionable manufacturing wastes.

Concord and Sudbury Rivers.

There has been little change in the condition of the Concord and Sudbury rivers as compared with previous years. The most objectionable pollution of the Sudbury River is at Saxonville, where the stream receives a large quantity of manufacturing waste and is notably polluted for a considerable distance below the village.

The condition of the Concord River above the city of Lowell has not been objectionable at any point during the past year. In the city of Lowell the river is badly polluted, especially by sewage from one of the main sewer outlets of the city which discharges into the stream a short distance above its confluence with the Merrimack. A plan for improving the condition of the Concord River was prepared by this Department several years ago, but the improvement has not been carried out.

Connecticut River.

The condition of this river has shown little change in the past year as compared with former years. It is not seriously polluted at any point at the present time.

Deerfield River.

The Deerfield River receives very little pollution through its course, except that which is caused by the sewage of the town of Greenfield, which is discharged into the river a short distance above its confluence with the Connecticut. The conditions about this outlet, however, have not been seriously objectionable during the past year.

French River.

The French River is very badly polluted at Webster by the sewage of the town and by manufacturing waste discharged from the mills. It is one of the most seriously polluted streams of the State, and investigations were begun just before the war for the removal of the sewage from this river and for its proper disposal. The work should be taken up again without delay and the pollution of the river by sewage prevented.

Hoosick River.

The Hoosick River is grossly polluted by the sewage of North Adams and Williamstown, and is offensive in the drier part of the year throughout its course from the North Adams sewer outlet to the point where it leaves the State. The region through which the river flows in Massachusetts is thickly populated and the river should be restored as soon as practicable to a proper sanitary condition, which can be accomplished by the removal of the sewage of North Adams and Williamstown and its treatment at suitable works.

Housatonic River.

The Housatonic River below Pittsfield has been somewhat more polluted than last year, though the increase has not been marked. In the lower part of its course in Stockbridge and Great Barrington there has been little change in its condition for several years. If all of the sewage of Pittsfield were pumped to the disposal works and filtered, the condition of the stream would not be noticeably objectionable at any point at the present time.

Merrimack River.

There has been little change in the condition of the Merrimack River throughout its course as compared with the previous year, and its condition has been considerably better in the past few years than formerly. Some of the tributaries of this river, notably Cochickewick Brook in North Andover, show an increase in pollution as compared with former years.

Miller's River.

The pollution of the Miller's River below Winchendon has increased somewhat during the past year, and there has been a slight increase in the pollution below Athol also, with little change in the remainder of its course. The river has not been noticeably objectionable at any point.

Neponset River.

The condition of the Neponset River has shown on the whole a slight deterioration in its upper waters above Hawes Brook as compared with the previous year. Hawes Brook below the tannery of the Winslow Brothers and Smith Company has been much more highly polluted than in the past two years, and the same is true of the condition of the river below Hawes Brook. In its course through the meadows, also, the pollution of the river has been greater than in the previous year, and its condition at Pauls bridge more objectionable than for several years. At its mouth at Milton Lower Mills the quantity of organic matter in the water of the river and the evidences of pollution have been somewhat greater than in the previous two years.

The difficulty in obtaining labor and chemicals for use as precipitants at the various works in this valley for the treatment of manufacturing wastes has for some time been serious, and these conditions have been largely responsible for the less efficient treatment of these wastes during the past year.

The sewage discharged at the disposal works at Norwood has been treated effectually during the year.

The town of Stoughton, at the headwaters of the Canton River, one of the principal tributaries of the Neponset River, which had been preparing for the construction of a sewage disposal system, found it necessary to postpone the work on account of the conditions brought about by the war. In the valley of the Canton River, also, the stream has been seriously polluted during the past year by wastes from a factory manufacturing khaki, disposal works for which have been partially completed. At other points in this valley there has been pollution of the streams by manufacturing waste which it has been found impracticable to prevent on account of the conditions brought about by the war.

Taunton River.

The condition of the Salisbury Plain River below Brockton has been very much worse than at any time since the Brockton sewerage works were completed, and this river was very badly polluted during the drier part of the year.

The Town River below Bridgewater also shows greater pollution than in any previous year, and the same is true of the condition of the Taunton River below the junction of the Town and Salisbury Plain rivers.

The Nemasket River also shows more evidence of pollution than for several years.

At Taunton there has been a deterioration in the condition of the Mill River, which has been badly polluted in its course through the city, and the quantity of organic matter in the water of the Taunton River itself below Taunton has been greater than in previous years.

Ten Mile River.

The Ten Mile River below Attleboro has been maintained in satisfactory condition during the past year.

Westfield River.

The most serious pollution of the Westfield River is that which is caused by the sewage of Westfield which is discharged into the river below the town. This river is not seriously polluted, and its condition has shown no material change as compared with previous years.

The results of chemical examinations of the more important rivers are presented in the following tables: —

Blackstone River.

CHEMICAL EXAMINATION OF WATER FROM BLACKSTONE RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Blackstone River, below Cherry Valley.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1909,	.35	13.93	3.34	.0681	.0470	.0334	.0136	3.70	.0125	.0003	.80	–
1910,	.32	16.42	3.92	.0633	.0489	.0387	.0102	4.02	.0146	.0002	.85	–
1911,	–	21.02	4.40	.1277	.0726	.0559	.0167	5.70	.0080	.0005	1.15	–
1912,[1]	–	44.10	11.04	.2514	.2884	.1023	.1861	10.70	.0002	.0004	3.08	–
1913,	–	32.32	6.52	.2591	.1628	.1122	.0506	8.18	.0015	.0004	2.06	–
1914,	–	44.73	7.27	.3430	.1857	.1379	.0478	12.83	.0000	.0001	2.12	–
1915,	–	19.23	5.15	.0985	.1142	.0785	.0357	3.08	–	–	1.89	–
1916,	–	14.18	5.27	.0209	.0809	.0544	.0265	1.25	–	–	1.50	–
1917,	–	20.67	7.48	.0406	.1279	.0762	.0517	2.36	–	–	2.20	–
1918,	–	18.43	4.95	.1209	.1125	.0666	.0459	2.10	–	–	1.48	–

[1] August omitted.

CHEMICAL EXAMINATION OF WATER FROM BLACKSTONE RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE — *Continued.*

Blackstone River, between Mill Brook Channel and the Sewage Precipitation Works of the City of Worcester.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Hardness.
		Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
1909,	–	52.97	18.55	.1865	.0381	.0239	.0142	4.80	.0033	.0010	–
1910,	0.15	50.92	18.97	.1933	.0545	.0309	.0236	4.07	.0023	.0009	–
1911,	0.11	44.64	15.70	.1920	.0449	.0212	.0237	4.03	.0170	.0009	–
1912,	0.10	40.05	10.91	.2047	.0352	.0225	.0127	3.58	.0027	.0011	–
1913,	0.10	35.17	10.34	.2767	.0491	.0285	.0206	3.18	.0003	.0008	–
1914,	0.14	35.03	8.23	.2993	.0771	.0510	.0261	3.85	.0012	.0018	–
1915,	0.13	39.00	11.68	.2383	.0650	.0392	.0258	2.96	–	–	–
1916,[1]	–	29.10	8.20	.2483	.0549	.0354	.0195	2.08	–	–	–
1917,[2]	0.23	42.38	11.04	.4864	.0612	.0379	.0233	2.19	–	–	–
1918,	0.20	37.36	10.23	.2917	.0728	.0322	.0406	2.23	–	–	–

[1] September omitted. [2] November omitted.

Blackstone River, below Sewage Precipitation Works.

1909,	–	53.79	12.12	1.0567	.1282	.0792	.0490	6.92	.0067	.0075	–
1910,	–	52.15	12.52	1.0090	.1654	.0817	.0837	5.68	.0015	.0034	–
1911,	0.21	53.25	13.15	.9967	.1608	.0651	.0957	6.54	.0152	.0072	–
1912,	0.23	48.90	10.08	1.1700	.1673	.0904	.0769	6.12	.0137	.0096	–
1913,[1]	0.28	40.68	10.46	.9320	.1286	.0719	.0567	4.49	.0158	.0084	–
1914,	0.25	43.46	9.08	.8577	.1114	.0770	.0344	4.87	.0038	.0091	–
1915,	0.13	39.45	6.77	.6370	.1032	.0575	.0457	3.58	–	–	–
1916,[1]	–	49.21	9.00	.6684	.1031	.0607	.0424	3.69	–	–	–
1917,[2]	–	50.37	12.46	.9350	.0926	.0610	.0316	4.25	–	–	–
1918,	0.61	39.03	8.40	.8590	.1370	.0687	.0683	3.42	–	–	–

[1] September omitted. [2] July omitted.

CHEMICAL EXAMINATION OF WATER FROM BLACKSTONE RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE — *Concluded.*

Blackstone River, at Uxbridge.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Hardness.
					ALBUMINOID.						
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
1909,	.22	18.31	4.35	.3473	.0273	.0216	.0057	3.64	.0325	.0066	–
1910,	.26	22.53	4.69	.4963	.0356	.0302	.0054	4.62	.0498	.0043	–
1911,	.26	23.10	3.85	.3717	.0293	.0225	.0068	4.15	.0558	.0173	–
1912,	.21	21.91	3.06	.4897	.0345	.0288	.0057	4.06	.0497	.0137	6.5
1913,	.29	19.48	3.70	.3880	.0355	.0281	.0074	3.34	.0382	.0107	5.5
1914,	.25	23.72	2.84	.5285	.0355	.0284	.0071	4.55	.0482	.0154	7.2
1915,	.30	19.63	2.75	.3068	.0381	.0302	.0079	3.10	–	–	6.3
1916,[1]	.32	20.42	4.72	.3766	.0376	.0293	.0083	2.74	–	–	6.3
1917,	.22	22.21	4.28	.3904	.0365	.0286	.0079	3.27	–	–	–
1918,	.36	19.23	4.12	.2555	.0354	.0280	.0074	3.26	–	–	–

[1] August omitted.

Blackstone River, at Millville.

1909,	.24	11.87	3.17	.1595	.0267	.0220	.0047	2.27	.0225	.0019	–
1910,	.30	13.94	3.32	.2350	.0277	.0234	.0043	3.01	.0290	.0013	–
1911,	.33	14.35	2.79	.1787	.0268	.0222	.0046	2.94	.0355	.0051	–
1912,	.29	15.20	2.18	.2433	.0283	.0249	.0034	2.91	.0421	.0064	–
1913,	.37	12.92	2.38	.1631	.0281	.0237	.0044	2.44	.0345	.0063	–
1914,	.28	14.33	2.78	.2245	.0304	.0243	.0061	2.78	.0233	.0065	–
1915,	.42	13.55	2.02	.1379	.0361	.0267	.0094	2.12	–	–	–
1916,	.38	13.31	2.78	.2284	.0266	.0199	.0067	1.86	–	–	–
1917,	.33	14.19	3.96	.1572	.0286	.0222	.0064	2.12	–	–	–
1918,	.42	13.47	3.33	.1166	.0334	.0252	.0082	2.21	–	–	–

Charles River.

CHEMICAL EXAMINATION OF WATER FROM CHARLES RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Charles River, above Milford.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
					ALBUMINOID.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914,[1]	.34	4.03	1.43	.0046	.0228	.0178	.0050	.41	.0000	.0000	.35	0.9
1915,[1]	.75	5.00	2.27	.0039	.0296	.0260	.0036	.41	–	–	.84	1.1
1916,[1]	.49	4.70	2.23	.0058	.0219	.0207	.0012	.37	–	–	.75	1.0
1917,	.43	4.96	1.58	.0062	.0197	.0157	.0040	.35	–	–	.53	1.3
1918,[2]	.37	4.15	1.26	.0096	.0209	.0155	.0054	.38	–	–	.41	1.2

[1] Three months. [2] Four months.

Charles River, below Milford.

1914,	.48	12.47	2.87	.2817	.0470	.0368	.0102	1.74	.0298	.0085	.74	3.3
1915,	.72	12.00	3.58	.1327	.0587	.0344	.0243	1.61	–	–	1.04	3.1
1916,[1]	.41	12.26	4.96	.1258	.0251	.0220	.0031	1.93	–	–	.81	2.9
1917,	.32	17.93	5.77	.4138	.0413	.0321	.0092	3.24	–	–	.49	3.7
1918,[2]	.61	10.33	3.10	.0519	.0531	.0366	.0165	1.71	–	–	.95	–

[1] October omitted. [2] Four months.

Charles River, opposite Pumping Station of Brookline Water Works.

1914,	.55	7.10	1.87	.0055	.0314	.0265	.0049	.92	.0032	.0001	.66	2.1
1916,[1]	.45	8.10	2.60	.0087	.0245	.0211	.0034	.96	–	–	.65	2.0
1917,	.70	7.93	2.72	.0053	.0394	.0270	.0124	.73	–	–	1.02	2.1
1918,[2]	.66	7.25	2.50	.0084	.0401	.0323	.0078	.86	–	–	.80	1.9

[1] Two months. [2] Three months.

Charles River, opposite Pumping Station of Waltham Water Works.

1914,	.52	7.45	1.98	.0117	.0353	.0297	.0056	.92	.0030	.0002	.57	2.6
1915,	.93	8.30	2.97	.0131	.0475	.0407	.0068	.91	–	–	1.11	2.3
1916,	.69	8.68	3.38	.0163	.0328	.0246	.0082	.89	–	–	.91	2.2
1917,	.67	7.68	2.75	.0109	.0310	.0282	.0028	.80	–	–	.71	2.3
1918,[1]	.49	6.60	2.27	.0101	.0384	.0272	.0112	.96	–	–	.61	2.2

[1] Three months.

Chicopee River.

CHEMICAL EXAMINATION OF WATER FROM CHICOPEE RIVER AND ITS TRIBUTARIES. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Ware River, below Ware.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914, . . .	.60	10.47	3.15	.0501	.0704	.0488	.0216	.53	.0012	.0006	.82	–
1915, . . .	.76	9.43	3.41	.0317	.0746	.0427	.0319	.42	–	–	1.16	–
1916, . . .	.79	7.37	2.82	.0148	.0451	.0334	.0117	.36	–	–	1.04	–
1917,[1] . . .	.53	8.38	2.68	.0529	.0630	.0376	.0254	.44	–	–	.74	–
1918, . . .	.66	8.08	3.26	.0319	.0647	.0414	.0233	.39	–	–	1.14	–

[1] July omitted.

Quaboag River, below Palmer.

1914, . . .	.49	6.62	1.62	.0144	.0243	.0176	.0067	.49	.0045	.0004	.35	–
1915, . . .	.56	6.00	2.12	.0128	.0336	.0236	.0100	.40	–	–	.62	–
1916, . . .	.64	6.02	2.54	.0134	.0278	.0209	.0069	.31	–	–	.70	–
1918,[1] . . .	.26	5.70	1.88	.0149	.0220	.0156	.0064	.45	–	–	.41	–

[1] Four months.

Swift River, below Bondsville.

1914, . . .	.35	4.97	1.67	.0037	.0304	.0219	.0085	.20	.0025	.0002	.55	–
1915, . . .	.46	4.95	1.83	.0052	.0269	.0202	.0067	.24	–	–	.64	–
1916, . . .	.49	4.22	1.67	.0026	.0193	.0160	.0033	.18	–	–	.69	–
1917, . . .	.33	5.07	2.02	.0034	.0224	.0166	.0058	.19	–	–	.50	–
1918, . . .	.34	4.35	1.63	.0055	.0197	.0155	.0042	.21	–	–	.49	–

Chicopee River, above Chicopee.

1914, . . .	.33	6.50	2.00	.0163	.0278	.0212	.0066	.51	.0095	.0008	.40	–
1915, . . .	.61	6.45	1.98	.0168	.0295	.0242	.0053	.39	–	–	.64	–
1916,[1] . . .	.69	6.15	2.35	.0126	.0236	.0194	.0042	.32	–	–	.72	–
1917,[2] . . .	.35	8.84	3.10	.0244	.0250	.0196	.0054	.36	–	–	.43	–
1918,[1] . . .	.38	6.25	2.00	.0351	.0373	.0282	.0091	.46	–	–	.50	–

[1] Four months. [2] June omitted.

Concord River.

CHEMICAL EXAMINATION OF WATER FROM CONCORD RIVER AND ITS TRIBUTARIES. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Sudbury River, below Saxonville.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914, . . .	.51	9.62	3.03	.0292	.0439	.0276	.0163	1.13	.0220	.0042	.61	–
1915, . . .	.97	6.67	2.75	.0129	.0408	.0319	.0089	.73	–	–	1.04	–
1916,[1] . . .	.62	7.20	2.10	.0315	.0311	.0264	.0047	.93	–	–	.74	–
1917, . . .	.52	7.30	2.70	.0185	.0481	.0306	.0175	.63	–	–	.73	–
1918, . . .	.52	6.68	2.52	.0158	.0340	.0242	.0098	.71	–	–	.59	–

[1] June omitted.

Assabet River, above Westborough.

1914, . . .	.92	7.37	2.78	.0088	.0356	.0304	.0052	.41	.0034	.0001	.98	–
1915, . . .	1.56	8.08	4.02	.0046	.0453	.0406	.0047	.46	–	–	1.74	–
1916, . . .	1.01	7.52	3.20	.0033	.0298	.0260	.0038	.47	–	–	1.24	–
1917, . . .	.82	8.11	3.43	.0088	.0325	.0281	.0044	.57	–	–	1.11	–
1918,[1] . . .	1.20	7.46	3.42	.0286	.0400	.0315	.0085	.56	–	–	1.31	–

[1] September omitted.

Assabet River, below Westborough.

1909, . . .	1.70	19.24	8.91	.4140	.2281	.1616	.0665	1.94	.0005	.0005	2.90	–
1910, . . .	2.23	17.07	7.00	.2898	.1334	.1018	.0316	2.16	.0078	.0018	2.20	–
1911, . . .	.83	12.09	4.01	.0556	.0460	.0373	.0087	1.87	.0967	.0121	1.24	–
1912, . . .	.66	12.71	4.01	.0975	.0419	.0357	.0062	2.20	.1998	.0132	.95	–
1913, . . .	1.15	9.67	4.21	.0152	.0448	.0401	.0047	1.08	.1078	.0016	1.37	–
1914, . . .	.80	10.21	3.14	.0089	.0399	.0339	.0060	1.59	.0195	.0005	1.01	–
1915, . . .	1.62	9.46	4.28	.0118	.0539	.0438	.0101	.87	–	–	1.83	–
1916, . . .	.88	11.30	4.38	.0807	.0360	.0319	.0041	1.87	–	–	1.12	–
1917, . . .	.80	10.08	3.68	.0428	.0381	.0352	.0029	1.03	–	–	1.04	–
1918,[1] . . .	.85	9.18	3.57	.0427	.0424	.0333	.0091	1.10	–	–	1.08	–

[1] September omitted.

CHEMICAL EXAMINATION OF WATER FROM CONCORD RIVER AND ITS TRIBUTARIES, ETC. — *Continued.*

Assabet River, above Hudson.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
					ALBUMINOID.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914, . . .	.44	6.80	2.10	.0066	.0275	.0222	.0053	.65	.0060	.0001	.53	–
1915, . . .	.82	6.48	2.63	.0064	.0325	.0305	.0020	.55	–	–	1.02	–
1916, . . .	.54	6.68	2.73	.0053	.0236	.0208	.0028	.61	–	–	.62	–
1917, . . .	.50	6.64	2.26	.0057	.0288	.0223	.0065	.55	–	–	.57	–
1918, . . .	.46	5.68	2.01	.0049	.0263	.0233	.0030	.71	–	–	.53	–

Assabet River below Hudson.

1909, . . .	.51	8.81	3.26	.0161	.0403	.0296	.0107	.98	.0022	.0002	.64	–
1910, . . .	.69	13.83	3.83	.0413	.0428	.0337	.0091	1.27	.0048	.0002	1.24	–
1911, . . .	.64	12.83	4.30	.0817	.0532	.0400	.0132	.90	.0043	.0003	1.06	–
1912, . . .	.78	18.08	3.99	.0939	.0752	.0494	.0258	1.02	.0053	.0002	1.28	–
1913,[1] . . .	.76	13.29	3.34	.0727	.0704	.0577	.0127	1.07	.0036	.0004	1.28	–
1914, . . .	.57	11.88	3.10	.0720	.0601	.0436	.0165	.98	.0042	.0002	1.03	–
1915, . . .	.90	8.25	3.17	.0144	.0466	.0356	.0110	.59	–	–	1.16	–
1916, . . .	.64	11.03	3.95	.0398	.0509	.0377	.0132	.70	–	–	.89	–
1917, . . .	.63	10.36	3.57	.0250	.0522	.0376	.0146	.65	–	–	.77	–
1918, . . .	.52	11.08	2.86	.0284	.0486	.0345	.0141	.77	–	–	.73	–

[1] November omitted.

Assabet River, above Maynard.

1914, . . .	.46	7.02	2.39	.0069	.0373	.0308	.0065	.82	.0014	.0002	.53	–
1915, . . .	.92	7.08	2 63	.0104	.0403	.0336	.0067	.63	–	–	1.03	–
1916, . . .	.64	7.25	2.47	.0127	.0302	.0260	.0042	.67	–	–	.81	–
1917, . . .	.57	7.95	2.57	.0204	.0361	.0276	.0085	.63	–	–	.68	–
1918, . . .	.64	7.63	2.33	.0154	.0363	.0325	.0038	.82	–	–	.75	–

CHEMICAL EXAMINATION OF WATER FROM CONCORD RIVER AND ITS TRIBUTARIES, ETC. — *Concluded.*

Assabet River, below Maynard.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1909, . . .	–	13.97	4.21	.1208	.0991	.0529	.0462	1.22	.0007	.0006	1.34	–
1910, . . .	.59	13.15	4.68	.0708	.0685	.0446	.0239	1.82	.0038	.0006	.85	–
1911, . . .	.58	12.73	4.17	.0738	.0650	.0408	.0242	1.41	.0060	.0006	1.08	–
1912, . . .	–	12.94	3.92	.1205	.0771	.0494	.0277	1.46	.0026	.0010	1.04	–
1913, . . .	.60	10.60	3.01	.0746	.0597	.0394	.0203	1.34	.0311	.0007	.85	–
1914, . . .	.33	11.58	2.87	.0705	.0595	.0378	.0217	1.32	.0056	.0012	.73	–
1915, . . .	.69	10.78	3.25	.0509	.0610	.0353	.0257	1.27	–	–	.99	–
1916, . . .	.83	11.27	3.98	.0191	.0576	.0364	.0212	1.13	–	–	1.32	–
1917, . . .	.67	12.08	4.14	.0684	.0832	.0440	.0392	1.30	–	–	1.07	–
1918, . . .	.57	10.27	3.42	.0233	.0559	.0369	.0190	1.13	–	–	.81	–

Concord River, at Billerica.

1914, . . .	.41	8.78	2.20	.0096	.0335	.0284	.0051	1.10	.0072	.0005	.50	–
1915, . . .	.88	7.92	2.93	.0157	.0411	.0375	.0036	.84	–	–	1.05	–
1916, . . .	.62	8.60	2.87	.0130	.0292	.0256	.0036	.85	–	–	.78	–
1917, . . .	.54	7.42	2.32	.0166	.0321	.0268	.0053	.94	–	–	.55	–
1918, . . .	.51	7.83	2.45	.0134	.0365	.0303	.0062	.94	–	–	.66	–

Connecticut River.

CHEMICAL EXAMINATION OF WATER FROM CONNECTICUT RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Connecticut River, at Northfield Farms.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
1914,	.29	8.03	2.73	.0056	.0182	.0137	.0045	.17	.0012	.0001	.70	–
1915,	.30	7.08	2.08	.0031	.0162	.0124	.0038	.17	–	–	.60	–
1916,[1]	.37	6.90	2.10	.0032	.0152	.0135	.0017	.14	–	–	.80	–
1917,[1]	.35	7.40	3.08	.0055	.0196	.0139	.0057	.13	–	–	.63	–
1918,	.33	6.93	2.20	.0041	.0186	.0142	.0044	.19	–	–	.80	–

[1] August omitted.

Connecticut River, below Springfield.

1914,	.29	7.92	2.50	.0185	.0243	.0178	.0065	.30	.0023	.0003	.82	–
1915,	.35	7.15	2.38	.0091	.0216	.0151	.0065	.24	–	–	.69	–
1916,	.37	7.82	3.09	.0067	.0173	.0143	.0030	.20	–	–	.77	–
1917,	.36	8.30	3.30	.0106	.0227	.0174	.0053	.22	–	–	.67	–
1918,	.33	7.48	2.60	.0168	.0236	.0149	.0087	.26	–	–	.77	–

Deerfield River.

CHEMICAL EXAMINATION OF WATER FROM DEERFIELD RIVER AND TRIBUTARY. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Deerfield River, at Shelburne Falls.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
1914,	.45	4.80	1.57	.0062	.0222	.0167	.0055	.17	.0022	.0003	.56	–
1915,	.27	4.58	1.44	.0042	.0149	.0121	.0028	.16	–	–	.39	–
1916,[1]	.34	4.50	2.23	.0033	.0129	.0117	.0012	.23	–	–	.55	–
1917,[2]	.22	4.97	1.90	.0035	.0113	.0093	.0020	.12	–	–	.20	–
1918,	.39	5.13	1.47	.0085	.0232	.0182	.0050	.23	–	–	.52	–

[1] Four months. [2] Three months.

CHEMICAL EXAMINATION OF WATER FROM DEERFIELD RIVER AND TRIBUTARY, ETC. — *Concluded.*

Deerfield River, below Green River.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914, . . .	.30	5.68	1.80	.0124	.0182	.0143	.0039	.19	.0020	.0001	.43	–
1915,[1] . . .	.22	5.41	1.28	.0211	.0195	.0128	.0067	.20	–	–	.34	–
1916, . . .	.29	5.60	1.47	.0226	.0160	.0127	.0033	.21	–	–	.43	–
1917,[2] . . .	.24	8.68	2.90	.0161	.0187	.0148	.0039	.20	–	–	.36	–
1918, . . .	.29	6.38	2.23	.0141	.0198	.0136	.0062	.25	–	–	.47	–

[1] Four months. [2] August omitted.

French River.

CHEMICAL EXAMINATION OF WATER FROM FRENCH RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

French River, below Webster.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914, . . .	.40	8.50	2.48	.0500	.0675	.0399	.0276	.72	.0018	.0027	.69	–
1915, . . .	.53	8.38	3.02	.0472	.0778	.0448	.0330	.80	–	–	.88	–
1916, . . .	.60	8.03	2.55	.0521	.0593	.0402	.0191	.84	–	–	.86	–
1917, . . .	.48	7.85	3.08	.0428	.0645	.0367	.0278	.61	–	–	.72	–
1918,[1] . . .	.50	9.00	3.75	.0162	.0779	.0416	.0363	.80	–	–	.96	–

[1] Four months.

Hoosick River.

CHEMICAL EXAMINATION OF WATER FROM HOOSICK RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Hoosick River, at Williamstown.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914, . . .	.39	18.62	4.02	.0670	.0584	.0381	.0203	.83	.0037	.0015	.63	9.5
1915, . . .	.21	12.65	2.60	.0351	.0316	.0202	.0114	.49	–	–	.32	6.9
1916,[1] . . .	.29	12.93	4.10	.0422	.0294	.0195	.0099	.67	–	–	.40	7.2
1917,[1] . . .	.22	14.54	4.96	.0585	.0328	.0197	.0131	.59	–	–	.35	–
1918,[2] . . .	.39	18.10	4.17	.0685	.0628	.0360	.0268	1.07	–	–	.76	–

[1] August omitted. [2] Three months.

Housatonic River.

CHEMICAL EXAMINATION OF WATER FROM HOUSATONIC RIVER AND ITS BRANCHES. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

East Branch, below Pittsfield.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914,[1] . . .	.24	13.82	3.27	.0509	.0351	.0271	.0080	.47	.0087	.0015	.53	–
1915, . . .	.37	11.98	3.23	.0527	.0304	.0236	.0068	.35	–	–	.60	–
1916, . . .	.34	12.67	4.00	.0496	.0292	.0225	.0067	.40	–	–	.54	–
1917, . . .	.07	11.41	3.38	.0228	.0247	.0159	.0088	.22	–	–	.31	–
1918,[2] . . .	.17	10.65	2.60	.0178	.0201	.0166	.0035	.34	–	–	.39	–

[1] Four months. [2] Two months.

West Branch, below Pittsfield.

1914,[1] . . .	.20	14.62	2.75	.0288	.0495	.0313	.0182	.45	.0017	.0011	.61	–
1915,[2] . . .	.34	16.62	3.72	.0671	.0691	.0359	.0332	.65	–	–	.63	–
1916, . . .	.18	12.93	3.78	.0568	.0432	.0228	.0204	.46	–	–	.29	–
1917, . . .	.20	14.00	4.43	.0429	.0378	.0204	.0174	.38	–	–	.49	–
1918,[3] . . .	.23	15.43	3.40	.0463	.0594	.0285	.0309	.65	–	–	.43	–

[1] Four months. [2] September omitted. [3] Three months.

CHEMICAL EXAMINATION OF WATER FROM HOUSATONIC RIVER AND ITS BRANCHES, ETC. — *Concluded.*

Southwest Branch, at Pittsfield.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914,[1] . . .	.16	15.05	2.30	.0098	.0259	.0166	.0093	.24	.0072	.0005	.37	–
1915, . . .	.14	15.25	2.95	.0070	.0243	.0159	.0084	.26	–	–	.30	–
1916, . . .	.15	14.97	4.69	.0038	.0197	.0122	.0075	.20	–	–	.30	–
1917, . . .	.17	16.98	4.30	.0326	.0292	.0172	.0120	.36	–	–	.35	–
1918,[2] . . .	.14	15.76	3.87	.0188	.0201	.0155	.0046	.32	–	–	.22	–

[1] Four months. [2] Three months.

Housatonic River, below Great Barrington.

1914,[1] . . .	.22	17.62	4.22	.0147	.0372	.0268	.0104	.69	.0112	.0023	.42	–
1915, . . .	.23	15.83	3.60	.0142	.0296	.0183	.0113	.46	–	–	.47	–
1916,[2] . . .	.22	15.40	5.80	.0143	.0230	.0174	.0056	.49	–	–	.40	–
1917,[3] . . .	.19	15.76	4.30	.0130	.0295	.0196	.0099	.52	–	–	.43	–
1918, . . .	.21	16.65	4.97	.0166	.0273	.0210	.0063	.61	–	–	.41	–

[1] Four months. [2] June omitted. [3] September omitted.

Merrimack River.

CHEMICAL EXAMINATION OF WATER FROM MERRIMACK RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Merrimack River, above Lowell.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914, . . .	.30	5.32	1.74	.0170	.0255	.0181	.0074	.35	.0037	.0003	.61	1.6
1915, . . .	.46	5.43	2.18	.0140	.0273	.0205	.0068	.32	–	–	.79	1.3
1916,[1] . . .	.50	6.02	2.06	.0078	.0197	.0169	.0028	.25	–	–	.77	1.3
1917, . . .	.34	6.58	2.12	.0117	.0222	.0166	.0056	.36	–	–	.54	1.4
1918, . . .	.37	5.88	2.05	.0140	.0238	.0191	.0047	.42	–	–	.72	1.5

[1] October omitted.

CHEMICAL EXAMINATION OF WATER FROM MERRIMACK RIVER, ETC. — *Concluded.*

Merrimack River, above Lawrence.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914, . . .	.23	6.85	2.62	.0280	.0246	.0201	.0045	.59	.0190	.0003	.59	1.7
1915, . . .	.33	7.05	2.83	.0183	.0230	.0177	.0053	.47	.0139	.0002	.69	1.6
1916, . . .	.47	6.89	2.77	.0143	.0211	.0146	.0065	.43	.0175	.0004	.55	1.4
1917, . . .	.44	6.54	2.53	.0147	.0203	.0169	.0034	.50	.0147	.0007	.47	1.2
1918, . . .	.45	7.10	2.88	.0176	.0233	.0174	.0059	.53	.0132	.0010	.66	1.2

Miller's River.

CHEMICAL EXAMINATION OF WATER FROM MILLER'S RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Miller's River, below Miller's Falls.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914, . . .	.44	5.17	1.85	.0073	.0251	.0204	.0047	.36	.0068	.0003	.49	–
1915, . . .	.88	5.77	2.75	.0092	.0311	.0256	.0055	.31	–	–	.93	–
1916, . . .	.80	4.85	2.14	.0093	.0274	.0212	.0062	.31	–	–	.97	–
1917, . . .	.75	5.90	2.75	.0058	.0281	.0224	.0057	.25	–	–	.78	–
1918, . . .	.62	4.90	1.67	.0058	.0267	.0226	.0041	.32	–	–	.73	–

Nashua River.

CHEMICAL EXAMINATION OF WATER FROM NASHUA RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

North Branch of Nashua River, below Fitchburg.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS—		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1909,	.52	15.85	3.42	.3220	.0958	.0563	.0395	1.87	.0027	.0014	1.02	–
1910,	.60	20.11	4.90	.4047	.1235	.0789	.0446	2.29	.0017	.0009	1.03	–
1911,	.51	19.38	5.57	.2848	.1035	.0566	.0469	2.37	.0027	.0015	1.15	–
1912,	.57	19.52	4.99	.2380	.1007	.0560	.0447	2.20	.0032	.0019	1.22	–
1913,	.40	23.45	4.97	.2770	.1064	.0561	.0503	2.02	.0028	.0013	1.42	5.0
1914,	.41	26.93	5.78	.3260	.1156	.0662	.0494	2.60	.0020	.0006	1.55	5.9
1915,[1]	.41	14.68	3.52	.0578	.0745	.0296	.0449	1.26	–	–	.94	3.1
1916,[2]	.42	18.52	5.12	.1043	.0778	.0380	.0398	2.12	–	–	1.03	3.2
1917,	.42	15.66	4.00	.0433	.0702	.0394	.0308	1.68	–	–	.74	–
1918,	.49	19.87	6.02	.0602	.0800	.0431	.0369	2.12	–	–	1.04	–

[1] October omitted. [2] August omitted.

North Branch of Nashua River, at Lancaster.

1909,	.44	12.26	3.41	.1556	.0330	.0284	.0046	1.46	.0360	.0066	.60	–
1910,	.45	13.44	3.82	.1655	.0462	.0366	.0096	1.63	.0388	.0108	.70	–
1911,	.51	15.64	4.10	.3067	.0828	.0408	.0420	1.95	.0208	.0083	.92	–
1912,	.45	12.65	3.10	.1252	.0438	.0275	.0163	1.68	.0343	.0083	.72	–
1913,	.43	15.45	3.02	.2292	.0533	.0386	.0147	1.75	.0133	.0053	.80	4.2
1914,	.39	16.80	3.15	.2147	.0466	.0336	.0130	1.94	.0262	.0115	.67	4.1
1915,	.42	12.10	3.49	.0757	.0465	.0294	.0171	1.31	–	–	.68	2.4
1916,[1]	.41	12.34	3.92	.0539	.0336	.0257	.0079	1.28	–	–	.73	2.7
1917,	.32	14.28	2.82	.0542	.0343	.0240	.0103	1.52	–	–	.51	–
1918,	.31	13.83	3.22	.0755	.0392	.0291	.0101	1.98	–	–	.55	3.4

[1] October omitted.

Nashua River, at Pepperell.

1914,[1]	.31	12.67	2.75	.0595	.0459	.0286	.0173	1.27	.0132	.0027	.59	–
1915,	.46	8.25	2.27	.0222	.0328	.0237	.0091	.85	–	–	.63	–
1916,[2]	.43	8.57	2.33	.0191	.0248	.0197	.0051	.78	–	–	.57	–
1917,	.39	10.96	4.06	.0434	.0357	.0204	.0153	1.25	–	–	.54	–
1918,	.31	10.75	3.00	.0338	.0305	.0210	.0095	1.53	–	–	.51	–

[1] Two months. [2] Three months.

Neponset River.

CHEMICAL EXAMINATION OF WATER FROM NEPONSET RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Neponset River, at Hyde Park.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
					ALBUMINOID.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1909, . . .	–	28.69	9.08	.1723	.1218	.0898	.0320	5.35	.0027	.0009	2.02	10.0
1910, . . .	–	31.37	10.16	.1740	.1333	.1000	.0333	5.84	.0010	.0002	2.96	10.4
1911, . . .	1.24	18.82	5.49	.0786	.0727	.0539	.0188	3.36	.0025	.0007	1.86	7.1
1912, . . .	.82	26.02	6.45	.1241	.1020	.0707	.0313	4.18	.0017	.0012	2.31	9.2
1913, . . .	1.02	26.13	6.22	.0533	.0757	.0494	.0263	3.93	.0020	.0007	2.29	7.9
1914, . . .	.93	20.27	4.37	.0754	.0697	.0484	.0213	3.43	.0025	.0008	1.31	5.2
1915,[1] . . .	1.23	19.67	6.30	.0530	.1078	.0649	.0429	2.42	–	–	1.92	5.3
1916, . . .	1.28	19.47	5.37	.0466	.0761	.0554	.0207	2.37	–	–	1.96	–
1917, . . .	.93	15.55	6.40	.0474	.0599	.0394	.0205	1.88	–	–	1.09	–
1918, . . .	.87	19.65	5.87	.0968	.0808	.0494	.0314	2.68	–	–	1.51	–

[1] Four months.

Quinebaug River.

CHEMICAL EXAMINATION OF WATER FROM QUINEBAUG RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE

Quinebaug River, below Southbridge.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
					ALBUMINOID.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914, . . .	.52	11.93	2.36	.3033	.0514	.0323	.0191	2.41	.0078	.0052	.47	–
1915, . . .	.68	7.56	2.49	.1499	.0457	.0327	.0130	.82	–	–	.91	–
1916, . . .	.54	8.12	3.32	.0867	.0367	.0266	.0101	.52	–	–	.76	–
1917, . . .	.42	5.32	1.65	.0380	.0297	.0201	.0096	.35	–	–	.47	–
1918, . . .	.50	7.35	2.77	.0471	.0351	.0256	.0095	.53	–	–	.64	–

Taunton River.

CHEMICAL EXAMINATION OF WATER FROM TAUNTON RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Taunton River, below Taunton.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914, . . .	.92	18.10	3.33	.0701	.0389	.0323	.0066	5.95	.0100	.0020	.88	–
1915, . . .	1.35	9.38	3.38	.0469	.0465	.0374	.0091	1.24	–	–	1.34	–
1916, . . .	1.70	9.58	3.72	.0323	.0424	.0341	.0083	1.20	–	–	1.74	–
1917, . . .	1.36	9.05	3.98	.0345	.0423	.0336	.0087	1.31	–	–	1.30	–
1918, . . .	1.25	9.43	3.73	.0578	.0514	.0382	.0132	1.23	–	–	1.40	–

Ten Mile River.

CHEMICAL EXAMINATION OF WATER FROM TEN MILE RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Ten Mile River, below Attleboro.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914, . . .	.51	15.32	3.09	.1909	.0673	.0401	.0272	1.73	.0300	.0087	.77	–
1915,[1] . . .	.88	11.10	3.30	.0954	.0494	.0346	.0148	1.37	–	–	.98	3.2
1916, . . .	–	13.23	3.42	.0912	.0510	.0340	.0170	1.66	–	–	.91	3.0
1917,[2] . . .	.72	10.62	3.72	.0613	.0349	.0250	.0099	1.08	–	–	.66	–
1918,[3] . . .	.56	10.46	3.73	.0221	.0584	.0317	.0267	1.14	–	–	.80	–

[1] June omitted. [2] November omitted. [3] Three months.

Westfield River.

CHEMICAL EXAMINATION OF WATER FROM WESTFIELD RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Westfield River, below Westfield.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914, . . .	.15	6.50	1.72	.0255	.0255	.0161	.0094	.33	.0101	.0013	.26	–
1915, . . .	.23	5.70	1.78	.0191	.0224	.0159	.0065	.27	–	–	.38	–
1916, . . .	.25	6.58	2.62	.0258	.0183	.0139	.0044	.26	–	–	.39	–
1917, . . .	.15	6.04	2.20	.0379	.0193	.0154	.0039	.31	–	–	.28	–
1918, . . .	.19	6.90	2.43	.0230	.0186	.0133	.0053	.32	–	–	.22	–

PROTECTION OF THE PUBLIC HEALTH IN THE VALLEY OF THE NEPONSET RIVER.

Upon the completion of the work of dredging the Neponset River, required by chapter 655 of the Acts of the year 1911, the State Department of Health was directed by the provisions of chapter 265 of the General Acts of the year 1916 to make return to the Treasurer of the Commonwealth, and to the assessors of the towns named in the act, of schedules and plans showing the parcels of land benefited by the work done or changes made under the act, the areas of the parcels, the names of the owners or occupants thereof so far as they can be ascertained, together with the amount of the benefits accruing to each of the parcels, etc., and an appropriation of $5,000 was made for carrying out the work.

At the beginning of the war the entire force which made the field surveys, the investigations as to ownership and as to the various parcels of land benefited by the work done entered the army, and other men engaged to take their places soon followed. In consequence the work was greatly delayed and its cost greatly increased.

In 1918 a further appropriation was made for completing this work. It has not been found practicable to secure sufficient assistance, however, and the work has been continued from time to time as rapidly as men could be obtained or spared for the purpose. The field work has now been practically completed, except such as may be necessary for

verification in a few areas. Practically all the land titles have been investigated and three-quarters of them checked. Ten maps have been made of the territory comprised in the meadows and are now in process of completion on a scale of 200 feet to the inch, and an index plan on a scale of 800 feet to the inch is being prepared. Observations are being made upon the height of ground water in various parts of the meadows, but plans of the results of these observations have yet to be made. If it is practicable to continue the work steadily with a suitable force, it can be finished in a few months in such form as to enable the Department to complete its work.

During the past year a company engaged in the preparation of peat for fuel, fertilizer and other uses has excavated pits in the deep layers of peat in the Purgatory Brook section of the Neponset valley. These pits have become filled with water and have been found to be breeding places for mosquitoes. Such pits if abandoned might entail considerable expense in future years for draining, filling or other work incidental to preventing nuisance and injury to health from mosquito growths. It is somewhat difficult to frame legislation to prevent nuisances of this sort without danger of interfering with desirable enterprises; nevertheless, some action is likely to be necessary to prevent danger of serious nuisance and trouble from this cause.

Pollution of a Stream in Mansfield by Manufacturing Wastes.

Early in July a petition was received from the town of Mansfield for action by the Department in relieving a serious nuisance in that town created by the discharge of manufacturing waste mingled with hot water into a swamp located in a populous neighborhood. In accordance with orders of the Department, a change was effected in the method of treatment and disposal of the wastes from the factory, and a considerable relief from the nuisance was effected before further serious trouble was removed by the advent of cold weather. Certain additional improvements in the disposal of waste at this factory will have to be effected before another summer if a further nuisance is to be prevented.

Work required by Special Legislation.

Under the legislation of 1918 a considerable amount of work was committed to this Department in connection with special investigations under the following special acts of the Legislature: —

Hale's Brook in Lowell. (Chapter 92, Resolves of 1917, and Chapter 24, Resolves of 1918.)

Disposal of sewage in the town of Ayer. (Chapter 58, Resolves of 1918.)

Use of water from the Ipswich River. (Chapter 73, Resolves of 1917, and Chapter 26, Resolves of 1918.)

Cost of a sewerage system to prevent the pollution of the Mystic Lakes. (Chapter 34, Resolves of 1918.)

Utilization of peat for fuel. (Chapter 49, Resolves of 1918.)

The engineering work in connection with the foregoing matters has been carried out by the Engineering Division of this Department. Special reports have been presented to the Legislature relating to Hale's Brook in Lowell, and to a sewerage system for the town of Ayer, but it has been impracticable to obtain the necessary engineering force to carry out all of the work committed to the Department by the above legislation, and an extension of time has been requested to complete the study of the question of further water supply from the Ipswich River and to make the investigation relative to a sewerage system to prevent the pollution of the Mystic Lakes.

Division of Water and Sewage Laboratories.

H. W. Clark, *Director and Chief Chemist.*

Report of Division of Water and Sewage Laboratories.

A large amount of analytical and research work concerning problems of water supply, water purification, sewage and sewage disposal, the treatment of trade wastes, etc., was done as usual by this Division during the year 1918. This work was carried on under the provisions of the act entitled "An Act to protect the purity of inland waters of the State," and also to carry out the provisions of many special acts concerning the public welfare and the public health as related to water supply, sewerage, conditions of rivers, etc.

During the year examinations were made of practically all the public water supplies in the State, of the rivers in the State to determine their degree of pollution, of the sewage applied to and of the effluents from sewage disposal areas, and of wastes from factories, together with many samples of effluent from the purification works at these factories, experimental purification plants, etc.

During 1918, 4,640 samples of water, sewage, etc., were analyzed in the State House laboratories, and 2,601 microscopical and special chemical examinations were made, divided approximately as follows: —

Samples from public water supplies: —	
Surface waters,	1,500
Ground waters,	952
Samples from rivers,	977
Samples from sewage disposal works: —	
Sewages,	404
Filter effluents,	587
Samples of wastes and effluents from factories,	153
Samples of sea water from various locations,	67
Special examinations of water for manganese, lead, nickel, copper, zinc, etc.,	233
Determinations of fats, alkalinity, etc.,	403
Microscopical examinations,	1,443
Determinations of dissolved oxygen, carbonic acid, etc. (field work),	522

Much necessary investigating or research work is carried on by this Division in regard to methods of treatment or purification of water, sewage, factory wastes, etc., and many filters and other apparatus are kept in operation at the experiment station in connection with these studies. The station is also the bacterial laboratory for all this work upon water supply, sewerage and sewage disposal.

At the station laboratories 5,817 examinations were made during the year, divided as follows: —

Samples examined on account of investigations concerning the disposal of domestic sewage, trade wastes, etc.,	1,023
Chemical examinations on account of investigations in connection with filtration and other treatments of water supplies, swimming pools, etc.,	708
Chemical examinations of sand from filter areas,	42
Mechanical examinations of sand from filter areas,	45
Bacterial examinations of water, sewage, ice, trade wastes, etc.,	3,962
Bacterial examinations of shellfish,	37

As indicated above, such investigations in regard to the treatment and purification of water, sewage, trade wastes, etc., as appeared to be essential to the work of the Department were carried on as usual during 1918, and the most important of these can be summarized as follows: —

Acid Treatment of Sewage. — During 1917 this Department made an investigation of the so-called "Miles acid process of sewage treatment," this process being, briefly, the treatment of sewage with SO gas for collection of the sludge present and the recovery of the valuable ingredients in this sludge. This investigation was made for a special commission of three, appointed by the Legislature, of which the State Commissioner of Health was a member. The results of this investigation were briefly summarized in a legislative document, House, No. 1215, January, 1918.

It seemed worth while, as the subject was important, to continue work on this method during 1918. The results of the work are given on subsequent pages, and they largely confirm the 1917 statements concerning the place of this process in sewage disposal work. Extensive investigations in regard to this Miles acid process were made at New Haven, Conn., during the year, and the results obtained there are in substantial agreement with those obtained by us during the past two years, namely, that it is a method of sewage treatment that may be used to advantage by some municipalities, but not with the expectation of financial profit.

Activated Sludge. — Further work of importance has been done with the activated sludge process of sewage disposal. One of the chief items of interest in this process is the possibility of the recovery of fairly stable sludge of commercial value, and this was quite thoroughly studied during the year with such activated sludge tanks as are in operation at Lawrence. The figures in regard to the entering sludge that can be recovered are given later, together with figures of the nitrogen and fat content of such sludge. It has been shown that in this process, as in all successful sewage purification processes, there is a large loss of nitrogenous and other organic matter due to the oxidizing conditions existing in these activated sludge tanks.

Further work has been carried on in regard to the purification of the effluents from such activated tanks, and much work done to determine the volume of air necessary for agitation of sewage in tanks of various depths and the volume necessary per gallon of sewage treated to obtain a satisfactorily purified effluent. Studies have also been continued in regard to the most satisfactory percentage of sludge compared with the total volume of sewage held by the activated sludge tanks that must be kept in agitation in the sewage to obtain satisfactory results. A fairly complete summary of this work is given later.

Treatment of Trickling Filter Effluents by the Activated Sludge Method. — Considerable study was made during the year in regard to the treatment by the activated sludge process of rather poorly purified trickling filter effluents such as come from filters of coarse filter material and operated at high rates, and the results have seemed to show that at certain trickling filter areas the effluent can be treated in this way to considerable advantage as far as end results are concerned, as shown later.

Recovery of Sludge from Trickling Filter Effluents. — At the present time studies are being made the world over in regard to the recovery of what has heretofore been considered at most sewage plants as unavoidable wastes, namely, the sludge or matters in suspension containing nitrogenous bodies and fats. Great efforts are being made at the present time to develop methods for the recovery of this material, and as one study of such recovery, considerable investigation has been made during the year regarding the amount of matter in suspension in trickling filter effluents; the value of this material; the rapidity of sedimentation of such material when these effluents are passed through suitable tanks, etc. The results summarized on following pages are of considerable interest, and show that from such sewage as we have experimented with, it is probable as much material of value can be recovered in this way as by the activated sludge process.

Study of the Manner and Time of Passage of Sewage through Sedimentation and Activated Sludge Tanks. — A short chapter is also given on this special subject in the continuation of the work described in the report for 1917. It is of great import in sewage treatment.

Filtration of Sewage. — Further studies regarding the important subject of the efficiency of trickling filters of different depths, of the operation of contact filters, and the results of the operation of three sand filters that have been receiving sewage at Lawrence for approximately thirty years, are summarized later.

Stabilizing Sludge with Filter Effluents. — Further work was done on the treatment and stabilization of crude sewage sludge in tanks through which sewage effluents rich in nitrates were passed. This work showed considerable promise, and indicates at least one way in which sludge at filter areas can be prevented from becoming a nuisance, and perhaps made of greater value from a fertilizer point of view.

Studies of Trade Wastes. — Much work was done as usual during the year in regard to the results obtained by the operation of filters, etc., treating liquid trade wastes at many industrial plants in the State. New and special investigations relating to the proper methods of disposal of such wastes and prevention of nuisances were also made.

Studies of Water. — The studies concerning the treatment of water included further investigations regarding the removal of color, investigations on the sterilization by ultra violet ray lamps of a new type, and on the use of chloramine, so called, etc., as shown on following pages.

Much work was done during the year studying the results of the Lawrence city filters and methods for their reconstruction and improvement; also a large amount of work was done regarding the treatment of the water supply of Beverly and Salem by filtration and liquid chlorine.

The personnel of the Division at the end of the year was as follows: —

Director of Division and Chief Chemist.

H. W. Clark.

Principal Assistant Chemists.

Fred B. Forbes (State House Laboratories).
George O. Adams (Lawrence Experiment Station).

Assistant Chemists and Bacteriologists.

State House Laboratories: —
Arthur R. G. Booth.
Lester W. Stickney.
Henry H. Andersen.
Guy G. Russell.

Lawrence Experiment Station: —
James H. Spurr.
William J. Magee.

Laboratory Assistants.

George H. Twombly (State House Laboratories).
Alfred H. Lindroth (State House Laboratories).
George E. Parkhurst (Lawrence Experiment Station).

Stenographer.

Isabelle J. Pratt.

Clerk.

Annie E. Holton.

Filter Attendant.

Patrick Keegan.

The following men from this Division were in the service during the year: —

Ernest F. Bower.	Allen M. Symonds.
Joseph A. McCarthy.	Walter D. Lowell.

Investigations upon the Purification of Sewage and Water at the Lawrence Experiment Station during the Year 1918.

Character of the Sewage used in the Experiments.

Since September, 1915, sewage has been pumped through a pipe from the Osgood Street sewer, so called, on the south side of the Merrimack River at a point above the entrance of any trade wastes. It is a strong domestic sewage, and was much stronger during 1918 than for several years past.

In this report "regular sewage," so called, is the average of samples collected four times each day of the sewage as it reaches the experiment station; "settled sewage" is the same sewage settled for at least two hours in cylindrical tanks; "sewage applied to Filters Nos. 1, 4 and 9A" is the average of daily samples of all sewages applied to the large intermittent sand filters situated out of doors.

Average analyses of these sewages for the year are shown in the following tables.

Preliminary Treatments of Sewage and Studies of Sludge.

Much attention was given during the year to a study of the collection of sludge and fats by sedimentation and by acidification, and to the recovery of sediment from trickling filter effluents and from an activated sludge tank.

Average Analyses.

Regular Station Sewage.

[Parts in 100,000.]

Ammonia.			Kjeldahl Nitrogen.		Chlorine.	Oxygen consumed.	Bacteria per Cubic Centimeter.
Free.	Albuminoid.						
	Total.	In Solution.	Total.	In Solution.			
5.48	1.01	.60	1.62	1.11	10.67	6.55	3,100,000

Settled Station Sewage.

5.19	0.78	.46	1.46	0.90	9.00	5.05	2,420,000

Sewage applied to Filters Nos. 1, 4 and 9A.

5.49	0.77	–	1.54	–	10.25	5.52	–

Average Solids.

Regular Station Sewage.

[Parts in 100,000.]

Unfiltered.			Filtered.			In Suspension.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
70.6	33.7	36.9	50.0	19.0	31.0	20.6	14.7	5.9

Settled Station Sewage.

56.9	24.5	32.4	42.4	15.4	27.0	14.5	9.1	5.4

Collection of Sludge from Sewage by Plain Sedimentation and by Acidification with SO_2 and Sedimentation.

In further work upon the recovery of sludge, parallel tests were made in regard to the collection of sludge by plain sedimentation and by sedimentation after acidification of the sewage by SO_2, about 160 gallons of sewage being used daily for each test. The tanks used were 3 feet deep, and four hours for sedimentation were allowed. After

settling, the supernatant sewage was drawn off daily and the sludge removed once each week. Sedimentation was not interfered with by fermentation during this period.

SO_2 was generated by burning sulphur and the resulting gases blown through the sewage, the SO_2 readily dissolving. The average alkalinity of the sewage used was equivalent to 27.6 parts calcium carbonate in 100,000, and the excess acidity was kept at about 10 per cent, the average being equivalent to 2.7 parts calcium carbonate.

The amount of SO_2 added was equivalent to 3,088 pounds per million gallons of sewage, and was calculated from the alkalinity of the sewage and the excess acidity after treatment, assuming that all the alkalinity of the sewage is converted to the bisulphite. This assumption is based on the facts that neither the sulphite nor bisulphite is acid to methyl orange, and when SO_2 is added to a dilute solution of a sulphite, no acidity is reached until all the sulphite is converted to bisulphite.

Samples of the freshly acidified sewage were titrated with iodine solution according to the following reactions: —

$$CaSO_3+I_2+H_2O=CaSO_4+2HI$$
$$CaH_2(SO_3)_2+2H_2O+2I_2=CaH_2(SO_4)_2+4HI$$

The calcium acid sulphate is unstable, breaking up into sulphuric acid and the normal sulphate. If sodium were the base the effect would be the same, as sodium acid sulphate is acid to the full extent of its combining power. In other words, if only neutral sulphite is present in the treated sewage, each molecule of sodium sulphite when titrated with iodine liberates acid equivalent to two molecules of sodium hydrate, but when the bisulphite is titrated the acid liberated is equivalent to three molecules of sodium hydrate. The amounts of acid actually found showed that practically all the alkalinity of the sewage had been converted to the bisulphite. The bisulphite oxidizes quite readily to the bisulphate, so that titrations of the excess acidity must be made promptly.

In the tables following the figures in regard to the amount of fats found are the average of the amounts obtained from each week's run, and not those derived from the average weight of sludge and the average per cent of fats.

Average analyses of the regular sewage used in the experiments, of the supernatant sewages after settling and of the sludges are shown in the following tables. Sludge is considered as consisting wholly of suspended solids, excluding the dissolved solids.

Sludge from Sedimentation and Acid Treatment of Sewage.

Sludge from —	Average Pounds per Million Gallons of Sewage.		Per Cent Nitrogen.	Per Cent Fats.	Per Cent Organic Matter.
	Dry Sludge.	Fats.			
Plain sedimentation, ...	1,504	262	3.36	18.1	64.0
Acid treatment, ...	1,983	420	3.92	21.0	73.8
Suspended solids in raw sewage, . .	1,875	–	–	–	67.2

As shown by the table, acid treatment gave an increase, above the amounts obtained from sedimentation, of 479 pounds of sludge per million gallons of sewage, or 32 per cent, while the fats were increased 158 pounds, or 60 per cent.

Regular Sewage.

[Parts in 100,000.]

Ammonia.			Kjeldahl Nitrogen.		Chlorine.	Oxygen consumed.	Alkalinity.
Free.	Albuminoid.						
	Total.	In Solution.	Total.	In Solution.			
6.25	1.02	.60	1.89	1.16	10.5	6.15	27.6

Supernatant Sewage from Plain Settling.

6.27	0.75	.50	1.33	0.97	–	4.43	–

Supernatant Sewage from Acid Treatment.

5.34	0.50	.38	1.60[1]	1.25[1]	–	–	—2.7

[1] These Kjeldahl values are undoubtedly high, and seem to be due to some combination of the free ammonia and the SO_2 that is not decomposed by alkali.

The bacteria, both those growing at 20° C. and at 37° C., were reduced 97 per cent by the SO_2 treatment. The reduction by plain settling was not determined, but from results of other settling tanks it was probably not over 15 per cent.

Acidification with Sulphuric Acid.

In further work along these lines, from Sept. 24 to Nov. 30, 1918, sulphuric acid was substituted for SO_2 in the acid treatment, but did not appear to be quite so efficient as the SO_2, although the results were not directly comparable. The sludge collected during the last part of the year was considerably higher in organic matter than that collected while SO_2 was used. The amount of acid used was equivalent to 2,344 pounds 100 per cent acid per million gallons of sewage treated.

SO_2 increased the yield of dry sludge 32 per cent, and of fats 60 per cent, over plain sedimentation; sulphuric acid increased the yield of dry sludge 22 per cent, and of fats 28 per cent, over plain sedimentation during the period it was used. The reduction of bacteria was not so good as when SO_2 was used, the average being about 85 per cent for both those growing at 20° C. and at 37° C., while the reduction by SO_2 was 97 per cent. The value of the greater bactericidal action of SO_2 is counterbalanced by the fact that the SO_2 and bisulphites in sewages treated with SO_2 absorb large amounts of dissolved oxygen from water into which such sewage is discharged.

It is doubtful if the increased amounts of sludge and fats resulting from acidification warrant the cost of such treatment. Sewage grease has been found to be of little value for soapmaking on account of the large proportion of unsaponifiable matter, although the increased yield of fats from acid treatment, resulting as it does from the decomposition of soaps, would also probably give an increased proportion of saponifiable fats.

Average Analyses.

Sludge from Plain Sedimentation and from Treatment of Sewage with Sulphuric Acid.[1]

Sludge from —	Average Pounds per Million Gallons of Sewage.		Per Cent Nitrogen.	Per Cent Fats.	Per Cent Organic Matter.
	Dry Sludge.	Fats.			
Plain sedimentation, ...	935	214	4.80	21.6	76.4
Sulphuric acid treatment, . . .	1,144	274	4.53	24.0	79.0
Suspended solids in raw sewage, . .	1,497	–	–	–	80.5

[1] From Sept. 24 to Nov. 30, 1918.

Average Analyses.

Regular Station Sewage.[1]

[Parts in 100,000.]

Ammonia.			Kjeldahl Nitrogen.		Chlorine.	Oxygen consumed.	Alkalinity.
Free.	Albuminoid.						
	Total.	In Solution.	Total.	In Solution.			
6.03	1.06	.58	1.78	1.15	9.1	5.30	26.4
Supernatant Sewage from Plain Settling.							
5.76	0.66	.49	1.25	1.01	-	3.93	-
Supernatant Sewage from Sulphuric Acid Treatment.							
4.98	0.51	.41	1.29	1.00	-	-	—2.3

[1] From Sept. 24 to Nov. 30, 1918.

Purification of Sewage by Aeration. — Activated Sludge.

Activated sludge Tank No. 485 was started on April 10, 1917, and has since been operated on the continuous-flow plan. It consists of three compartments, or sections, made of 30-inch Akron pipe set in concrete bases, and each section is about 75 inches deep over a conical bottom, and has a capacity of 230 gallons, or a total tank capacity of 690 gallons. The first two sections are each divided across the middle into two compartments by wooden baffles 6 feet deep. The overflow from the last section is piped to a square, concrete cased, iron, sloped bottom settling tank, 92 inches deep, with a capacity of 600 gallons. The overflow of this settling tank is passed upward through a tank 10 feet deep, holding 160 gallons. During the year the average suspended solids in this final effluent were 2.7 parts in 100,000.

Sludge from the settling tanks is drawn at intervals of an hour or so into a 200-gallon iron, sludge storage tank, where it is aerated with the same proportion of air as is used in the main tank. During the first six months of the year this sludge was pumped back to the first section twice a day, and later three times a day. The average theoretical time of retention of sewage in the tank was 5.38 hours, and the average time of active operation, that is, while sewage was being applied, was

fifteen hours daily. The amount of air applied was 1.78 cubic feet per gallon of sewage until May 1, when it was gradually increased to 2.80 cubic feet, the average being 2.32 cubic feet per gallon of sewage. This air was applied through perforated, hollow, circular brass discs placed in the bottom of each section of the tank.

The dissolved oxygen in the sewage of each of the three sections varied from 0 to 60 per cent of saturation, the average for each being 14, 21 and 22 per cent, respectively. Eighty-three per cent of the samples of effluent tested were stable on incubation. Practically all of the unstable samples were collected early in the year when the air supply was insufficient. The nitrates in the effluent contained oxygen derived from the dissolved oxygen, the average being equivalent to 0.87 part dissolved oxygen.

During the year certain experiments were made in regard to the maintenance of aerobic conditions in the tank by the use of sodium nitrate; that is to say, during nights, when the air supply was discontinued, enough of this salt was added to the sewage in each section of the tank to saturate at least twice with dissolved oxygen the entire contents of the tank. Careful tests were made, showing that the amount of nitrates added was always consumed, and hence no nitrates from this source appeared in the effluent.

It was intended to keep the volume of activated sludge used equal to about 20 per cent of the total volume of the tank, and on seventeen occasions surplus sludge was pumped to waste. The amount of sludge so wasted, that might have been recovered as fertilizing material, was equivalent to 770 pounds of dry sludge per million gallons of sewage passed through the tank, and it contained 6.15 per cent nitrogen and 5 per cent fats. The effluent from the tank was of much better quality during the last six months than during its earlier operation, this being due to the greater volume of air used, more frequent withdrawals of surplus sludge and to better aeration of the sludge.

Filtration of the Effluent from an Activated Sludge Tank through Sand.

Filter No. 495, $\frac{1}{20000}$ of an acre in area, containing 5 feet in depth of sand with an effective size of .25 millimeter, was started on March 18, 1918. It received the effluent from activated sludge Tank No. 485 at a rate of 100,000 gallons per acre daily. The effluent was clear and well nitrified, but the color and albuminoid ammonia were somewhat higher than would have been expected from an applied sewage that had had such a good preliminary treatment.

Average Analyses.

Regular Station Sewage applied to Activated Sludge Tank No. 485.

[Parts in 100,000.]

Appearance.		Ammonia.			Kjeldahl Nitrogen.		Chlorine.	Nitrogen as —		Oxygen consumed.	Alkalinity.	Bacteria per Cubic Centimeter.
			Albuminoid.									
Turbidity.	Color.	Free.	Total.	In Solution.	Total.	In Solution.		Nitrates.	Nitrites.			
–	–	5.22	.75	.48	1.65	1.02	9.72	–	–	6.20	–	3,100,000

Effluent from Activated Sludge Tank No. 485.

0.5	.67	3.37	.26	.19	.58	.37	10.02	.19	.0824	1.58	20.3	660,000

Effluent from Filter No. 495.

0.0	.32	0.51	.06	–	–	–	10.68	2.80	.0146	0.55	2.6	10,000

Average Solids.

Regular Station Sewage applied to Activated Sludge Tank No. 485.

[Parts in 100,000.]

Unfiltered.			Filtered.			In Suspension.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
71.4	33.7	37.7	49.4	19.8	29.6	22.0	13.9	8.1

Effluent from Activated Sludge Tank No. 485.

44.8	13.1	31.7	42.1	11.2	30.9	2.7	1.9	0.8

Volume of Air required for Efficient Agitation.

Experiments have been made during the year with Tank No. 485 in regard to the amount of sludge which will be well agitated and held in suspension in the sewage by different volumes of air expressed in cubic feet of air per hour per million gallons of sewage aerated. The results given in the following table show that in this tank, 9 feet in depth, at

least 100,000 cubic feet per hour per million gallons are needed. In the table the amount of matter held in suspension in the sewage agitated by these different volumes of air is shown by the volume settling at different times in liter cylinders of sewage collected from the activated sludge tank.

Amount of Air applied (Cubic Feet).	Per Cent of Sludge by Volume after settling —			
	15 Minutes.	30 Minutes.	1 Hour.	12 Hours.
50,000, ...	17.7	14.6	12.1	9.9
100,000, ...	30.8	24.6	21.0	13.8
200,000, ...	31.0	25.0	21.0	13.9
300,000, ...	32.0	24.5	21.0	14.0

Activated Sludge Experiments in Regard to the Effect of Varying Volumes of Sludge.

On March 18 an experiment was started to study the effect on the activated sludge process of the use of different volumes of sludge. Gallon bottles were used as miniature activated sludge tanks operated on the fill and draw plan, with one filling daily, a three-hour period of aeration and one and one-half hours' settling before withdrawal of the treated sewage. The sludge was aerated practically continuously.

Activated sludge from Tank No. 485, containing 4.7 per cent total suspended solids, was used to start the experiment, and 10, 20 and 30 per cent, respectively, of the total capacity of each bottle was filled with the sludge. At first, air was applied at the rate of 25 gallons per hour per gallon of sewage; but after the expiration of three weeks, only one-third of this volume of air was used. As the sludge in the bottles accumulated, the surplus was removed. In each case the treated sewage contained very little dissolved oxygen, but was always stable and clear, with a certain amount of light-colored, slow-settling suspended matter present. The average amount of suspended matter in the three effluents was 3.5, 2.2 and 2.0 parts in 100,000, respectively. These effluents were of practically equal quality, only slightly greater efficiency being given by the use of the larger amounts of sludge. The most noticeable differences were in the amounts of surplus sludge collected in each bottle, and in the nitrogen content of the different sludges, the amount of surplus sludge collected varying directly, and the nitrogen content varying inversely, as the amount of sludge maintained in the tank.

Average Analyses of Applied Sewage and Effluents.

[Parts in 100,000.]

	Ammonia.			Nitrogen as —		Oxygen consumed.
	Free.	Albuminoid.				
		Total.	In Solution.	Nitrates.	Nitrites.	
Applied sewage,	6.50	.90	.49	–	–	5.60
Effluent from: —						
10 per cent sludge bottle,	4.06	.23	.16	.50	.1080	1.38
20 per cent sludge bottle,	3.93	.20	.14	.84	.0240	1.03
30 per cent sludge bottle,	3.65	.17	.15	.77	.0300	1.06

Average Analyses of Sludge removed from Bottles.

Per Cent.	Bottle No. 1, 10 Per Cent Sludge.	Bottle No. 2, 20 Per Cent Sludge.	Bottle No. 3, 30 Per Cent Sludge.
Nitrogen,	5.20	4.71	4.29
Fats,	3.00	1.90	2.10
Loss on ignition,	57.90	59.90	53.20

The total suspended solids in the sewage used in these experiments were equal to 2,291 pounds per million gallons, and the organic suspended solids were equal to 1,399 pounds.

The surplus total suspended solids from the bottles containing 10, 20 and 30 per cent sludge, expressed in pounds per million gallons of sewage applied, were 2,108, 2,343 and 2,414, respectively, and the organic matter in the sludge, 961, 822 and 1,191 pounds, respectively.

Stabilizing Sewage Sludge by Oxidation with Nitrates from Sewage Filter Effluents.

This investigation in regard to the treatment of sludge to destroy its offensive properties and render its disposal at certain municipal filtration areas free from all but slight odors was continued during the year. The work was carried on with Tank No. 483, which is made of Akron pipe set in concrete, consisting of three compartments, 4 feet deep, connected in series, each with a capacity of about 65 gallons. Sewage sludge was passed into these compartments in rotation, and a maximum storage of three months was given. The inlets and overflows of the

tank are so arranged that the effluents applied passed through all three compartments, entering at the bottom and leaving about 6 inches below the surface of each.

The greater part of the effluent used came from trickling filters, although some contact filter effluents were also applied. The volume applied daily averaged 1.10 volumes of effluent for each volume of sludge containing 5 per cent of solids in the three compartments; that is, each gallon of sludge was treated with about 100 gallons of effluent. Forty-three per cent of the samples of overflow were stable, and the solids in suspension were 7.3 parts in 100,000.

The sludge after four weeks' tank treatment was always inoffensive, and almost invariably remained so when removed from the tank. During this process the sludge lost nitrogen and organic matter; the fats were oxidized as in the activated sludge process, but in the activated sludge tank there was a constant addition of coagulated colloidal matter, high in nitrogen and organic matter and low in fats.

Average analyses of the applied filter effluent, of the overflow from the last compartment, and sludge analyses on a dry basis are shown in the following tables: —

Effluent applied to Tank No. 483.

[Parts in 100,000.]

Ammonia.			Kjeldahl Nitrogen.	Nitrogen as —		Oxygen consumed.
Free.	Albuminoid.					
	Total.	In Solution.		Nitrates.	Nitrites.	
3.00	.45	.26	.81	2.16	.1255	2.76

Overflow from Tank No. 483.

3.51	.35	.25	.64	0.41	.0940	2.38

Sludge Analyses.

Sludge from —	Per Cent on Dry Basis of —		
	Fats.	Nitrogen.	Loss on Ignition.
Activated Sludge Tank No. 485,	5.0	6.15	64.7
Settling tank applied to Tank No. 483,	18.1	2.61	56.9
Tank No. 483: —			
After 4 weeks,	10.9	2.10	43.6
After 8 weeks,	8.8	2.13	44.4
After 12 weeks,	8.7	1.93	41.0

Experiments upon the Recovery of Sediment from Trickling Filter Effluents.

On account of the interest attached to the recovery of fertilizing materials from sewage and treated sewage, some sedimentation experiments were made to determine the proportions of the sediment that can be recovered from trickling filter effluents. In this work, at first the combined effluents from three trickling filters, Nos. 453, 454 and 474, were run into a circular tank, 5 feet deep and 20 inches in diameter, and samples collected midway of the tank after two hours' settling. The average suspended solids in the combined effluents during the six months of the experiment were 19.9 parts in 100,000, and after settling, 2.9 parts, — a reduction of 86 per cent.

In another experiment lasting three months the effluent from Filter No. 452 was settled in a tank 27 inches deep. The suspended solids before settling were 23.4 parts in 100,000, and after settling, 0.8 part, — a reduction of 97 per cent. In this case the high reduction was probably partly due to coagulation taking place during the sedimentation, as the soluble albuminoid ammonia was reduced from .25 to .17 part in 100,000 during the two hours' sedimentation.

The following table indicates the amount of settleable matter in the effluents from all the trickling filters at the station, and the amount of sludge recovered from activated sludge Tank No. 485.

Average Suspended Solids in Trickling Filter Effluents, etc.

Suspended Solids in Effluent from —	Pounds per Million Gallons.
Filter No. 135,	758
Filter No. 452,	825
Filter No. 453,	971
Filter No. 454,	733
Filter No. 455,	704
Filter No. 472,	708
Filter No. 473,	675
Filter No. 474,	683
Filter No. 475,	933
Settled sewage applied to filters above,	1,205
Regular sewage applied to activated sludge Tank No. 485,	1,608
Surplus sludge removed from Tank No. 485,	770

The average amount of settleable suspended matter in the effluents from trickling filters was 777 pounds per million gallons, or 64 per cent of the amount found in the sewage applied; the total suspended matter in the sludge removed from activated sludge Tank No. 485 averaged 770 pounds per million gallons, or 48 per cent of that in the sewage applied.

Aeration of a Somewhat Poor Trickling Filter Effluent with Activated Sludge.

A portion of the effluent from trickling filter No. 452, containing 4 feet in depth of broken stone, and operated at the rate of 1,500,000 gallons per acre daily, was treated in a small activated sludge tank, 20 inches in diameter and 36 inches deep, during a period of several months. The sludge was the sediment collected from trickling filter effluents, activated by a few days' aeration. Air was applied at a rate of about 1.25 cubic feet per gallon of effluent treated.

The results from this treatment appeared to be abnormally good, and there seemed to have been coagulation and precipitation, as the soluble albuminoid ammonia was decidedly reduced. All samples of the raw, settled and aerated effluent were stable except one at the immediate start of the experiment.

Average analyses are shown in the following table: —

Average Analyses.

Effluent from Trickling Filter No. 452 before Aeration with Activated Sludge.

[Parts in 100,000.]

Appearance.			Ammonia.			Nitrogen as —		Oxygen consumed.	Total Suspended Solids.
			Free.	Albuminoid.					
Turbidity.	Sediment.	Color.		Total.	In Solution.	Nitrates.	Nitrites.		
0.9	8.4	.71	2.32	.46	.21	.54	.1163	3.21	20.8

Effluent from Trickling Filter No. 452 after Aeration with Activated Sludge.

0.3	0.5	.60	1.80	.14	.11	.78	.0965	1.02	0.8

Operation of Trickling Filters.

During the year nine trickling filters receiving sewage clarified by sedimentation were operated. One of these filters, No. 135, has now been in operation for nineteen years, — a longer time, without doubt,

than any other trickling filter, either experimental or municipal, in America. It contains 10 feet in depth of pieces of fine broken stone having an average volume of .52 cubic centimeter. All of this stone passes a 1-inch screen, but is retained by a $\frac{1}{4}$-inch screen. In spite of the fineness of this material it has been necessary to dig over the filter surface to a depth of from 3 to 8 inches only eight times up to April, 1918. At that time the open space of the upper foot of stone was found to be completely filled with sludge, and 18 inches in depth were removed, washed and replaced. The remainder of the filter was then flushed out with water equivalent to 1,000,000 gallons per acre applied in fifteen minutes. The dry sludge washed from the upper 18 inches of stone was equal to 1.84 pounds per cubic foot of material, while the amount flushed from the lower $8\frac{1}{2}$ feet of the filter was equal to .03 pound per cubic foot. Measurements of the sludge stored in the filter showed that there has been little increase since 1906, when similar measurements were made.

The Depth of Filtering Material and Trickling Filter Efficiency.

It has been shown and illustrated by diagrams, and explained in previous reports, that filters of considerable depth are more economical and efficient than shallower filters. To illustrate this point, four filters, Nos. 452 to 455, inclusive, were put into operation in 1913, and were continued through the year. These filters are 4, 6, 8 and 10 feet in depth, respectively, and are constructed of broken stone that will pass a $1\frac{1}{2}$-inch screen and be retained by a $\frac{3}{4}$-inch screen. Certain experiments made during the year with these filters are not recorded here, but a table beyond shows the rates that could be followed with equal purification results.

A similar series of filters, Nos. 472 to 475, inclusive, was started in 1915. In this second series the broken stone is of a much larger grade than that in the first, the average volume of the pieces ranging from 25.2 to 29.4 cubic centimeters. These filters were also operated at such rates that the effluents were of approximately the same quality. The coarse material of these filters has only about one-half as much surface per foot in depth of filter as the finer material in Filters Nos. 452 to 455, inclusive, and sewage passes through the filters in a correspondingly shorter time, giving a lower purification at a given rate.

Average Rates and Results. — Trickling Filters.

Filter Number.	Depth (Feet).	Gallons filtered per Acre Daily per Foot of Filter Depth.		Per Cent of Samples Stable.	
		During 1918.	Since Filter was started.	During 1918.	Since Filter was started.
452, ...	4	50,000	92,000	100	87
453, ...	6	78,000	115,000	100	92
454, ...	8	116,000	192,000	100	98
455, ...	10	203,000	348,000	100	84
472, ...	4	86,000	84,000	68	49
473, ...	6	83,000	108,000	90	75
474, ...	8	114,000	117,000	90	83
475, ...	10	116,000	142,000	85	87

Average Analyses.

Effluents from Trickling Filters Nos. 135, 452, 453, 454, 455, 472, 473, 474 and 475.

[Parts in 100,000.]

Filter Number.	Quantity applied. — Gallons per Acre Daily.	Ammonia.			Kjeldahl Nitrogen.	Chlorine.	Nitrogen as —		Oxygen consumed.	Alkalinity.	Bacteria per Cubic Centimeter.
		Free.	Albuminoid. Total.	Albuminoid. In Solution.			Nitrates.	Nitrites.			
135, . . .	1,320,000	3.0540	.4233	.2610	.78	8.86	1.75	.0642	2.62	13.1	580,000
452, . . .	204,000	3.4250	.5012	.3240	.88	7.82	2.51	.0510	2.35	10.6	330,000
453, . . .	468,000	4.0420	.4552	.3330	.81	7.80	2.01	.0432	2.55	12.4	400,000
454, . . .	931,000	3.2320	.3532	.2542	.63	7.92	1.89	.0632	2.16	11.7	180,000
455, . . .	2,034,000	4.2420	.3660	.2810	.66	7.50	.85	.0540	2.18	15.9	340,000
472, . . .	344,000	2.8950	.4383	.2827	.81	9.12	1.39	.1301	2.69	13.0	640,000
473, . . .	500,000	3.1570	.4254	.2855	.73	8.99	1.77	.0654	2.49	13.3	620,000
474, . . .	916,000	2.9630	.4215	.2797	.79	8.83	1.40	.1620	2.58	12.9	1,120,000
475, . . .	1,163,000	3.0170	.4200	.2516	.83	8.83	1.68	.0646	2.78	12.4	860,000

Average Solids.

Effluents from Filters Nos. 135, 452, 453, 454, 455, 472, 473, 474 and 475.

[Parts in 100,000.]

Filter Number.	Unfiltered.			Filtered.			In Suspension.		
	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
135, . . .	55.6	21.9	33.7	46.5	16.9	29.6	9.1	5.0	4.1
452, . . .	54.5	22.8	31.7	47.8	19.5	28.3	6.7	3.3	3.4
453, . . .	54.1	23.1	31.0	44.3	17.0	27.3	9.8	6.1	3.7
454, . . .	48.0	18.9	29.1	43.8	17.0	26.8	4.2	1.9	2.3
455, . . .	40.2	14.4	25.8	37.5	13.5	24.0	2.7	0.9	1.8
472, . . .	54.0	20.3	33.7	45.5	15.7	29.8	8.5	4.6	3.9
473, . . .	55.5	22.2	33.3	47.4	17.2	30.2	8.1	5.0	3.1
474, . . .	52.9	20.7	32.2	44.7	15.9	28.8	8.2	4.8	3.4
475, . . .	56.6	22.9	33.7	45.4	17.2	28.2	11.2	5.7	5.5

Operation of Contact Filters.

Contact filters at the station are operated largely to study their permanency and to demonstrate to students, engineers, sewerage commissioners, etc., the construction, method of operation and results obtainable with such filters. Three were operated during the year.

Filter No. 175 has been in operation since 1901, a period of seventeen years, and is constructed of 4 feet in depth of coke of such size that all will pass a 1-inch screen, 75 per cent a $\frac{1}{2}$-inch screen and practically none a $\frac{1}{4}$-inch screen. At the end of 1911, owing to clogging, it was necessary to remove and wash all of the filter material. For sixteen years the filter received sewage that had been screened through fine coke or coal, but for the last two years it has received settled sewage. It is flooded once daily, stands full two hours before draining, and is allowed to rest every sixth week. Seventy-nine per cent of the samples of effluent were stable. At the end of the year the loss of open space was 50 per cent, an increase during the year of 7 per cent.

Filter No. 425 was put into operation in January, 1911, and is constructed of 33 inches in depth of soft coal clinker having a diameter between $\frac{1}{4}$ inch and $1\frac{1}{4}$ inches. It is filled twice daily, stands full one hour before draining, and allowed to rest every sixth week. The loss of open space at the end of the year was 58 per cent, an increase of 6 per cent during the year.

Double Contact Filtration.

Filter No. 443, constructed of 21 inches in depth of broken stone pebbles all of which will pass a $\frac{1}{2}$-inch screen, 43 per cent a $\frac{1}{4}$-inch screen and practically none a $\frac{1}{8}$-inch screen, was started in April, 1912, and has been operated twice daily as a secondary contact filter receiving the effluent from Filter No. 425, and allowed to rest every sixth week. All samples of the effluent were stable. The loss of open space at the end of the year was 58 per cent, an increase of 18 per cent.

Average Analyses.

Effluent from Filter No. 175.

[Parts in 100,000.]

Quantity applied. Gallons per Acre.	Ammonia.			Kjeldahl Nitrogen.	Chlorine.	Nitrogen as —		Oxygen consumed.	Alkalinity.	Bacteria per Cubic Centimeter.
		Albuminoid.								
	Free.	Total.	In Solution.			Nitrates.	Nitrites.			
363,000	2.0150	.3246	.2320	.66	9.43	1.04	.0973	2.48	12.0	1,330,000

Effluent from Filter No. 425.

358,000	1.5510	.4930	.2518	.88	9.21	1.57	.1048	2.99	8.8	840,000

Effluent from Filter No. 443.

357,000	1.0300	.2788	.1683	.57	8.97	2.17	.0943	2.06	5.2	1,080,000

Average Solids.

Effluent from Filter No. 175.

[Parts in 100,000.]

Unfiltered.			Filtered.			In Suspension.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
48.9	16.4	32.5	43.6	13.1	30.5	5.3	3.3	2.0

Effluent from Filter No. 425.

63.2	24.7	38.5	46.4	14.7	31.7	16.8	10.0	6.8

Average Solids — Concluded.

Effluent from Filter No. 443.

[Parts in 100,000.]

Unfiltered.			Filtered.			In Suspension.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
58.8	22.6	36.2	53.3	19.1	34.2	5.5	3.5	2.0

Intermittent Sand Filters operated with Untreated Sewage. — Filters Nos. 1, 4 and 9A.

Each of these three sand filters is $\frac{1}{200}$ of an acre in area, and at the end of the year Filters Nos. 1 and 4 had been operated continuously for nearly thirty-one years, and Filter No. 9A had been operated twenty-eight years. These filters are probably the oldest regularly operated sewage filters in this country, and are kept in operation to demonstrate the permanency of such filters when properly cared for. Regular station sewage without preliminary clarification has always been applied to them, and for many years it has been the practice to apply only as much sewage to each filter as can be purified without materially increasing the amount of organic matter stored within the filter. Since 1893, a period of about twenty-five years, each of these filters has been operated without the removal of any surface sand.

The depth and size of sand of which each filter is constructed, the date when first put into operation, the total volume of sewage treated upon each filter since it was started, and the volume of sewage applied daily during the year are shown in the following table: —

Filter Number.	Depth (Feet).	Effective Size of Sand (Millimeter).	Date first operated.	Actual Volume of Sewage applied since Start (Gallons.)	Volume of Sewage applied daily during 1918 (Gallons per Acre).
1, ...	5	.48	Dec. 10, 1888	3,028,600	44,100
4, ...	5	.04	Dec. 19, 1887	1,056,090	19,400
9A, ...	5	.17	Nov. 18, 1890	2,516,530	44,000

For a number of years the surface of Filters Nos. 1 and 9A have been leveled during the summer, but have been trenched and ridged

during the winter. The surface of Filter No. 4 is arranged in circular trenches, 14 inches wide, which are filled to a depth of 12 inches with sand of an effective size of .48 millimeter. The sewage is applied to these trenches, grass being permitted to grow on the ridges. During the year the surface of the filters was dug over twice to a depth of from 8 to 10 inches, and raked to a depth of 2 inches on twelve, seventeen and fifteen different occasions, respectively. Board coverings were put over the trenches on December 5 and removed on March 28.

An examination of the sands in Filters Nos. 1 and 9A is made about the 1st of July each year. As has been previously stated, the greater part of the stored organic matter is in the first foot of sand, and a following table shows analyses for the past ten years. There was a certain accumulation during the year due to the application of sewage stronger than usual.

The average analyses of the effluents from these filters are shown in the following tables: —

Average Analyses.

Effluent from Filter No. 1.

[Parts in 100,000.]

Temperature (Degrees F.).		Ammonia.		Chlorine.	Nitrogen as —		Oxygen consumed.	Alkalinity.	Bacteria per Cubic Centimeter.
Applied.	Effluent.	Free.	Total Albuminoid.		Nitrates.	Nitrites.			
59	51	1.2680	.0760	9.53	4.08	.0062	.76	—0.7	5,900

Effluent from Filter No. 4.

60	51	0.3613	.0334	8.52	3.87	.0366	.46	—1.2	310

Effluent from Filter No. 9A.

57	53	1.1108	.0704	7.98	3.80	.0028	.82	—0.3	3,300

Sand Analyses.

Albuminoid Ammonia in First Foot of Sand in Filters Nos. 1 and 9A.

[Parts in 100,000.]

Year.	Filter No. 1.	Filter No. 9A.
1909,	52.7	69.3
1910,	66.1	56.5
1911,	45.6	65.1
1912,	74.0	83.9
1913,	77.3	74.8
1914,	95.2	76.0
1915,	74.9	81.1
1916,	80.8	70.0
1917,	83.0	79.2
1918,	106.0	86.3

Flow of Sewage through Sedimentation and Activated Sludge Tanks.

During 1918 an investigation in regard to the method of flow of liquids through sedimentation and activated sludge tanks was continued, this study having been begun during 1917. Not as much was accomplished along this line as could be desired, owing to the limited time that could be given to it.

Two experiments were made in the first place in regard to the passage of sewage through the wooden tank, 31 feet long, 31 inches wide and 30 inches deep, mentioned in the previous report, and in which fourteen baffles were placed for this experimental work, the sewage going through passing alternately above and below each baffle through openings 6 inches high and of the width of the tank, namely, 31 inches.

As in the tests discussed last year, a certain amount of ammonium chloride solution was mixed with the water in the tank and then displaced by canal water entering at the desired rate. In these two experiments theoretical storages of four and six hours were used. The baffles used prevented to a considerable extent the retention and mixture of the passing sewage, and hence shortened in each experiment the actual period of passage, making it more nearly conform to the theoretical period than when the tank was used as a sedimentation tank without baffles, or only with the insertion of one or two, as in previous experiments. With the tank baffled as completely as stated, practically 95 per cent of the sewage passed through in each experiment in the theoretical time; namely, four and six hours.

Further experiments on the passage of sewage through activated sludge tanks, baffled or divided in such a way that they contained from two to five sections, were made. These experiments are being continued, and will be reported on with diagrams in the next annual report.

Treatment and Filtration of Water.

Removal of Color from Water.

Following preliminary experiments, two filters were started in May, 1917, to study the removal of color by sand impregnated with ferric hydrate.

One of these filters, No. 487, was $23\frac{1}{2}$ inches in diameter, and contained 2 feet in depth of sand of an effective size of .34 millimeter. In the sand of this filter nearly 22 tons per acre of ferric sulphate was precipitated by alternate applications of caustic soda and ferric sulphate solutions.

Filter No. 488 is 10 inches in diameter, and contains 4 feet in depth of sand of an effective size of .25 millimeter. In preparing this filter for color removal the same proportion of ferric sulphate was used, but magnesium oxide was mixed with the sand to furnish the alkali to precipitate the iron. Both filters were operated at a rate of 5,000,000 gallons per acre daily, and the results of their operation up to Nov. 1, 1917, are summarized in the report for that year. Filter No. 487 was stopped at that time.

On Jan. 7, 1918, a third filter, No. 494, was started, of the same depth and grade of sand as in Filter No. 488. In the sand of this filter 36 tons per acre of commercial aluminum sulphate was precipitated by alternate applications of aluminum sulphate and soda ash. In discussing the results of Filter No. 488, the period from the start in May, 1917, to Nov. 1, 1918, will be covered.

When filters containing precipitated iron are first started, the color removal is over 90 per cent. Gradually the color-removing properties decrease, until after thirty-five or forty days they will have decreased one-half. The filter is then thoroughly drained, and caustic soda, usually at the rate of 10 tons per acre, — dissolved in just water enough to fill the open space of the sand, — is applied to the filter, and after standing over night drained out. After this treatment, at least three days, at the usual rate of operation, are required to wash out the excess caustic.

The average period between treatments with caustic to dissolve out organic matter has been forty-one days. During 1918 this treatment with caustic had the effect of keeping the surface of the filters clean,

and no scrapings were necessary. Filter No. 494 was operated an average of thirty-nine days between treatments, and no appreciable amount of aluminum hydrate was dissolved by the application of the caustic soda solution.

By this caustic treatment 65 and 48 per cent, respectively, of the coloring matter removed from the water and retained in the sand was removed from Filters Nos. 488 and 494, and 42 and 34 per cent of the albuminoid ammonia and 55 and 45 per cent, respectively, of the organic matter.

On several occasions, after the caustic treatment and before all the caustic was entirely washed out, additional amounts of ferric sulphate or aluminum sulphate were applied to the two filters. The total amount of ferric sulphate applied to Filter No. 488 during the period under discussion was 42.8 tons per acre, equivalent to .24 grain per gallon of water filtered, and the caustic soda used was equivalent to .52 grain per gallon. A total of 41.5 tons per acre of aluminum sulphate was applied to Filter No. 494, equivalent to .59 grain per gallon, and caustic soda equivalent to .64 grain per gallon of water filtered.

The ferric sulphate applied to Filter No. 488 is expressed in terms of 100 per cent material, while the aluminum sulphate applied to Filter No. 494 was the commercial salt containing from 50 to 60 per cent actual aluminum sulphate.

The maximum amount of chemicals that can be added to each filter without reducing the open space of the sand has not been even approached as yet, this being shown clearly by the slight loss of head encountered in the operation of these filters. The caustic treatment is largely responsible for this, as it dissolves the organic matter from the surface of the filter.

Filter No. 488 for some months has given a color reduction of from 50 to 60 per cent. It has been operated sixteen months, and the indications are that this efficiency can be continued many months more. About half of the stored organic matters have been removed by the caustic treatment, but as there is notwithstanding this a constant accumulation of organic matter the time will come when the sand will have to be removed and washed or replaced with new sand.

Filter No. 494 has not been quite as efficient as Filter No. 488, but it contains only about half as much precipitated material. Tables showing results follow: —

Average Analyses.

Canal Water, May, 1917, to November, 1918.

[Parts in 100,000.]

Color.	Ammonia.			Nitrogen as —		Oxygen consumed.	Iron.	Alkalinity.	Soap Hardness.
	Free.	Albuminoid.		Nitrates.	Nitrites.				
		Total.	In Solution.						
.41	.0193	.0214	.0154	.022	.0009	.53	.0497	0.9	1.1
Effluent from Filter No. 488, May, 1917, to November, 1918.									
.15	.0103	.0088	–	.023	.0014	.23	.0131	1.2	1.2
Effluent from Filter No. 494, January, 1918, to November, 1918.									
.16	.0163	.0099	–	.022	.0014	.26	.0177	1.3	1.4

Efficiency of a New Type of Lamp in the Sterilization of Merrimack River Water with Ultra Violet Rays.

In 1915 tests were made at the experiment station on the efficiency of ultra violet rays in sterilizing raw and partly purified Merrimack River water.[1] Since then the R. U. V. Company have made a new type of lamp for which greater efficiency is claimed, and during 1918 tests of this lamp were made at the station, river water being run through the apparatus at the rate of 60 gallons per hour. During each test covering a period of twenty days, samples were collected each hour for five hours beginning when the lamp had been lighted one hour,

The average results of these twenty series with the new lamp are shown in the following table. With a polluted water, such as the Merrimack River water, at least, the new type of lamp appears to be little improvement over the old.

Average Bacterial Analyses.

Lamp.	River Water (Bacteria per Cubic Centimeter).			River Water after Radiation (Bacteria per Cubic Centimeter).			Per Cent of Bacteria removed.		
	20° C.	37° C.		20° C.	37° C.		20° C.	37° C.	
		Total.	Red.		Total.	Red.		Total.	Red.
Old type, . . .	17,000	355	210	370	20	3	98	94	99
New type, . . .	22,000	490	390	290	11	5	99	98	99

[1] Annual report for 1915, p. 421.

Average B. Coli Results.

Lamp.	River Water (Per Cent of Samples containing B. Coli).				River Water after Radiation (Per Cent of Samples containing B. Coli).			
	.001 c. c.	.01 c. c.	0.1 c. c.	1 c. c.	0.1 c. c.	1 c. c.	10 c. c.	100 c. c.
Old type, ...	33.3	55.5	100	100	0	6	56	100
New type, ...	5.0	85.0	100	100	0	13	62	100

The Use of Chloramine in the Treatment of Water.

Chloramine is a name applied to certain aromatic compounds containing the NCl linkage, and in connection with water sterilization is applied to the product that is supposed to result from the reaction of calcium hypochlorite and ammonium hydroxide in dilute solutions at low temperatures. Considerable has been written about its use during the past few years, and results of preliminary experiments at the station were given in the last report.

In further work on the treatment of polluted water in this way, a 60-gallon galvanized storage tank was used, the bleach and ammonia solutions were stored in separate tanks and mixed just before being added to the raw water. The apparatus was so operated that one hour's contact of water and chemicals was always given. Varying amounts of bleach alone, and the same amounts of bleach with one-half as much ammonia, were tried through a series of tests lasting about two months, five samples of the treated water being examined each day, and the results of each series are shown in following tables. The results obtained with bleach and ammonia do not seem to show any great advantage over the use of bleach alone.

The Use of Chloramine in the Disinfection of Swimming Pools.

In continued studies of the efficiency of chloramine, its use in connection with hypochlorite of lime was tried out at the swimming pool of the Lawrence Y. M. C. A. In the first experiments the required amount of ammonia was added to the pool just before the addition of hypochlorite. Applied in this way the ammonia apparently had no effect; afterwards, the bleach was mixed with 8 gallons of water and strained and the ammonia added just before the distribution of this treated water throughout the pool. The amount of bleach regularly used was equivalent to 0.5 part in 1,000,000 available chlorine, and when ammonia was used, 0.25 part in 1,000,000 was added to the bleach. The addition of ammonia under the conditions described was entirely without effect in the reduction of bacteria.

Average Bacterial Analyses.

Raw Water (Bacteria per Cubic Centimeter).			Chemicals added (Parts in 1,000,000).	Water after Treatment (Bacteria per Cubic Centimeter).			Per Cent of Bacteria removed.		
20° C.	37° C.			20° C.	37° C.		20° C.	37° C.	
	Total.	Red.			Total.	Red.		Total.	Red.
4,000	250	80	.25 available chlorine, .	1,100	90	45	73	64	44
2,640	114	64	.25 available chlorine, .125 ammonia.	644	27	10	75	76	84
3,700	600	170	.50 available chlorine, .	48	20	0	98	96	100
5,900	800	150	.50 available chlorine, .25 ammonia.	16	14	0	99	98	100

Average B. Coli Results.

Raw Water (Per Cent of Samples containing B. Coli).				Chemicals added (Parts in 1,000,000).	Water after Treatment (Per Cent of Samples containing B. Coli).		
.001 c. c.	.01 c. c.	0.1 c. c.	1.0 c. c.		0.1 c. c.	1 c. c.	10 c. c.
50	100	100	100	.25 available chlorine, . . .	100	100	100
10	100	100	100	.25 available chlorine, .125 ammonia.	30	72	100
0	60	100	100	.50 available chlorine, . . .	0	0	0
0	60	100	100	.50 available chlorine, .25 ammonia.	0	0	0

Work of Experimental Filter upon the Beverly and Salem Water Supply.

The water supply of Beverly and Salem is taken from Wenham Lake. During the past two years the water in this lake has been added to materially by water taken from the Ipswich River, pumped during that portion of the year when the flow of the river is above a stated volume. Connection by means of a canal and pipe line has been made, and a pumping station installed to pump this water over into Wenham Lake.

On July 1, 1916, an experimental filter, $\frac{1}{207}$ acre in area, was put into operation at the lake. This filter is of wood, concrete lined, 10 feet deep, and contains 5 feet in depth of sand of an effective size of 0.27 millimeter and a uniformity coefficient of 3.3. The filter has been operated uniformly at a rate of 3,000,000 gallons per acre daily. Very many samples, both chemical and bacterial, of the water applied to and of the effluent from this filter have been taken since its installation. It is not thought necessary to give these analyses in detail here,

but averages are given covering a period of practically two and one-half years.

At the pumping station for raising the Ipswich River water to Wenham Lake the water is lifted about 20 feet, and at this station a liquid chlorine apparatus is located. During the year various tests of the efficiency of this apparatus in the treatment of Ipswich River water were made, and the results are shown in a following table, this table giving also the amounts of available chlorine added, in parts in 1,000,000, and the color of the Ipswich River water treated. The Ipswich River water, much of which comes from swamps, is one of the highly colored river waters of the State, and, as will be seen by the table, colors varying from 1.50 to even 2.50, as shown by our color standard, are found. The experimental filter has delivered uniformly a safe, satisfactory water, and has removed about 24 per cent of the color of the applied water. Detailed reports in regard to the work accomplished by the chlorine apparatus and the experimental filter have been made to the Department.

Average Chemical Analyses.

Water applied to Experimental Filter, — August, 1916, to September, 1918, inclusive.

[Parts in 100,000.]

Color.	Ammonia.				Oxygen consumed.	Hardness.	Iron.
	Free.	Albuminoid.					
		Total.	In Solution.	In Suspension.			
.37	.0105	.0224	.0183	.0043	.42	2.2	.035

Effluent from Experimental Filter, — August, 1916, to September, 1918, inclusive.

.28	.0026	.0145	-	-	.28	2.4	.019

Average Bacterial Analyses.

Results of the Experimental Filter at the Salem Pumping Station from July, 1916, to September, 1918, inclusive.

Date.	Number of Days tested.	Lake Water before Filtration.						Lake Water after Filtration.					
		Bacteria per Cubic Centimeter.			Per Cent of Samples containing B. Coli.			Bacteria per Cubic Centimeter.			Per Cent of Samples containing B. Coli.		
		20° C.	37° C.		0.1 c. c.	1 c. c.	10 c. c.	20° C.	37° C.		0.1 c. c.	1 c. c.	10 c. c.
			Total.	Red.					Total.	Red.			
1916.													
July,	2	160	13	4	50	100	100	110	7	0	0	0	0
August,	4	200	58	12	0	50	100	53	4	0	0	0	25
September,	3	70	14	1	0	0	33	320	2	0	0	0	33
October,	6	83	11	1	0	17	33	10	2	0	0	0	16
November,	6	150	14	5	0	17	33	70	6	2	0	16	16
December,	2	14	7	0	0	0	0	70	13	0	0	0	0
1917.													
January,	5	100	3	0	0	0	60	64	1	0	0	0	0
February,	2	140	4	1	0	0	0	26	1	0	0	0	0
March,	2	3,900	30	5	0	50	50	50	15	0	0	0	0
April,	2	130	30	0	0	0	0	18	10	0	0	0	0
May,	2	140	35	1	0	0	50	50	15	0	0	0	50
June,	2	190	80	40	0	0	100	50	15	3	0	0	0
July,	3	120	43	26	0	66	66	50	12	7	0	33	33
August,	2	200	10	2	0	50	50	70	5	0	0	0	0
September,	1	70	2	0	0	0	100	68	7	4	0	0	50
November,	3	30	2	1	0	0	0	8	1	0	0	0	0
1918.													
January,	1	3,300	22	3	0	0	0	150	9	1	0	0	0
February,	3	13,000	90	8	0	0	66	2,200	40	0	0	0	0
March,	3	760	60	7	0	0	33	130	33	0	0	0	0
April,	1	2,600	280	0	0	0	0	150	50	0	0	0	0
May,	1	42	26	0	0	0	0	12	7	0	0	0	0
June,	1	250	25	0	0	0	0	50	7	0	0	0	0
July,	1	32	5	0	0	0	0	50	14	0	0	0	0
September,	2	44	10	0	0	0	50	4	2	0	0	0	0
Average,	–	1,100	35	5	2	15	38	160	12	7	0	2	9

Average Bacterial Analyses.

Ipswich River Water before and after Treatment with Chlorine, May, 1916, to April, 1918, inclusive.

Date.	Before Treatment with Chlorine.				Chlorine added (Parts in 1,000,000).	After Treatment with Chlorine.			
	Color.	Bacteria per cubic centimeter.				Color.	Bacteria per cubic centimeter.		
		20° C.	37° C.				20° C.	37° C.	
			Total.	Red.				Total.	Red.
1916.									
May 23,	1.88	220	22	6	0.46	1.85	315	10	2
May 31,	2.23	177	12	3	0.17	2.11	50	7	0
August 7,	1.61	130	9	4	0.41	1.66	117	6	2
1917.									
January 10,	1.13	1,100	86	6	1.10	1.18	54	16	0
January 16,	1.40	1,350	22	3	1.00	1.40	825	20	1
January 29,	1.19	340	15	2	1.04	1.19	25	14	0
March 12,	.83	1,940	40	11	0.39	.78	74	31	1
1918.									
February 15,	.93	7,700	190	55	0.86	.95	620	21	1
February 20,	.80	91,000	220	16	0.74	.80	1,200	150	0
February 28,	.75	12,000	340	1	0.65	.75	550	370	0
March 20,	.78	3,000	65	0	0.53	.79	120	35	0
March 28,	1.06	600	28	0	0.54	1.03	41	18	0
April 3,	1.16	900	70	0	0.57	1.15	78	53	0
April 11,	1.11	150	19	0	0.62	1.06	28	17	0
Average,	1.20	8,600	80	8	0.64	1.20	300	50	0.5

B. coli results are not given in the above table because in all this work the organism was found very infrequently in the untreated river water and seldom when smaller volumes than 10 cubic centimeters were tested. By chlorine treatment about 50 per cent removal was obtained.

Average Bacterial Analyses of Wenham Lake Water.

Date.	Average Number of Samples.	Color.	Bacteria per Cubic Centimeter.			B. Coli in —		
			4 Days, 20° C.	Total.	Red.	0.1 c. c.	1 c. c.	10 c. c.
1916.								
April 6,	1	–	450	11	0	0	0	+
May 23,	1	.32	300	10	0	0	0	0
June 28,	1	–	144	26	12	0	0	+
July 28,	1	–	280	30	6	0	+	+
September 29,	1	–	330	40	10	0	+	+
1917.								
May 24,	1	.64	160	15	2	0	+	+
June 25,	2	.42	165	85	50	0	0	+
July 24,	1	.49	65	4	1	0	0	+
August 21,	1	.37	280	2	0	0	0	0
September 20,	1	.37	110	1	0	0	0	+
November 30,	1	.32	23	1	0	0	0	0
1918.								
May 13,	2	.60	560	8	0	0	0	0
June 6,	1	.38	270	20	0	0	0	0
July 2,	1	.45	40	14	2	0	+	+
September 5,	1	–	80	12	1	0	0	+
Average,	1	.44	220	18	6	0	27+[1]	67+[1]

[1] Per cent.

Lawrence City Filters.

The city of Lawrence takes its supply of water from the Merrimack River, which is badly polluted by the entrance of sewage and mill wastes of cities and towns above Lawrence. Since 1893, a period of twenty-five years, the city has purified this water by sand filtration.

Two filters are used, — one, constructed in 1893, is 2.2 acres in area and divided into three sections by concrete dividing walls, and contains 4 feet in depth of sand of an effective size of approximately 0.25 millimeter; the other, of modern construction, entirely of concrete, covered, etc., was constructed in 1907. This filter has an area of three-quarters of an acre, and contains about $4\frac{1}{2}$ feet in depth of sand of an effective size of 0.25 millimeter.

The effluents from these filters flow into the same pump-well, and

from this they are pumped to a distributing reservoir. During 1917 the easterly section of the old filter was in part reconstructed, a tight concrete bottom and sides being built, and during 1918 this reconstruction was finished, this section being roofed in. The remaining two sections had all their pipe and gravel underdrains renewed and extended during the year. The average volume of water pumped daily from both filters up to September 1, when a portion of the open filter was put out of operation, was about 4,310,000 gallons, and during the year it was necessary to supply the city with a certain volume of water from the Andover and North Andover systems.

The average chemical and bacterial analyses of the effluents from these two filters, and of samples from other points on the Lawrence water supply system, are shown in the following tables: —

Average Chemical Analyses.

Merrimack River. — Intake of the Lawrence City Filters.

[Parts in 100,000.]

Temperature (Degrees F.).	Appearance.		Ammonia.			Chlorine.	Nitrogen as —		Oxygen consumed.	Iron.	Soap Hardness.
				Albuminoid.							
	Turbidity.	Color.	Free.	Total.	In Solution.		Nitrates.	Nitrites.			
48	0.3	.40	.0213	.0224	.0173	.49	.019	.0009	.57	.0448	1.1

Effluent from Lawrence City Filter (Old Filter).

51	0.2	.39	.0147	.0117	–	.48	.038	.0009	.42	.0747	1.3

Effluent from Lawrence City Filter (New Filter).

51	0.0	.29	.0091	.0103	–	.49	.030	.0006	.42	.0343	1.2

Water from the Outlet of the Distributing Reservoir.

52	0.1	.37	.0089	.0112	–	.51	.035	.0006	.38	.0673	1.2

Average Chemical Analyses — Concluded.

Water from a Tap at Lawrence City Hall.

[Parts in 100,000.]

Temperature (Degrees F.).	Appearance.		Ammonia.			Chlorine.	Nitrogen as —		Oxygen consumed.	Iron.	Soap Hardness.
				Albuminoid.							
	Turbidity.	Color.	Free.	Total.	In Solution.		Nitrates.	Nitrites.			
52	0.1	.34	.0076	.0095	–	.51	.035	.0005	.36	.0638	1.3

Water from a Tap at the Lawrence Experiment Station.

54	0.1	.28	.0025	.0123	–	.46	.024	.0002	.29	.0485	1.1

Average Bacterial Analyses.

Merrimack River. — Intake of the Lawrence City Filters.

Bacteria per Cubic Centimeter.			Per Cent of Bacteria removed.			Per Cent of Samples containing B. Coli.			
20° C.	37° C.		20° C.	37° C.		.01 c. c.	0.1 c. c.	1 c. c.	10 c. c.
	Total.	Red.		Total.	Red.				
18,000	1,400	400	–	–	–	70	98	100	–

Effluent from the Lawrence City Filter (Old Filter).

180	13	2	99.0	99.5	99.5	–	12	22	73

Effluent from the Lawrence City Filter (New Filter).

80	8	2	99.5	99.4	99.5	–	0	24	75

Mixed Effluents as pumped to Distributing Reservoir.

190	12	2	–	–	–	–	19	30	82

Water from the Outlet of the Distributing Reservoir.

200	14	1	–	–	–	–	6	23	68

Average Bacterial Analyses — Concluded.

Water from a Tap at Lawrence City Hall.

Bacteria per Cubic Centimeter.			Per Cent of Bacteria removed.			Per Cent of Samples containing B. Coli.			
20° C.	37° C.		20° C.	37° C.		.01 c. c.	0.1 c. c.	1 c. c.	10 c. c.
	Total.	Red.		Total.	Red.				
100	10	1	–	–	–	–	0	11	35

Water from a Tap at the Lawrence Experiment Station.

150	10	1	–	–	–	–	6	10	49

Refiltration of Lawrence City Water.

Filter No. 343A, $\frac{1}{20000}$ of an acre in area, started in 1908, was continued in operation during 1918, and at the end of the year contained 28 inches in depth of sand of an effective size of 0.35 millimeter. Since July, 1913, water from the city mains has been applied at a theoretical rate of 5,000,000 gallons per acre daily. The average color removal by this filter was 33 per cent; 61 per cent of the iron in the applied city water was removed, and 80 per cent of the bacteria.

Average Chemical Analyses.

City Water applied to Filter No. 343A.

[Parts in 100,000.]

Quantity applied. — Gallons per Acre.	Appearance.		Ammonia.		Chlorine.	Nitrogen as —		Oxygen consumed.	Iron.	Alkalinity.	Soap Hardness.
	Turbidity.	Color.	Free.	Total Albuminoid.		Nitrates.	Nitrites.				
–	0.1	.30	.0052	.0135	.53	.031	.0003	.32	.0545	1.0	1.2

Effluent from Filter No. 343A.

4,785,000	0.0	.20	.0047	.0089	.52	.033	.0002	.26	.0214	1.1	1.2

Average Bacterial Analyses.

Bacteria per Cubic Centimeter.			Per Cent of Bacteria removed.			Per Cent of Samples containing B. Coli.		
20° C.	37° C.		20° C.	37° C.		0.1 c. c.	1 c. c.	10 c. c.
	Total.	Red.		Total.	Red.			
150	10	1	–	–	–	–	10	49
Effluent from Filter No. 343A.								
30	3	0	80	70	100	–	7	12

DIVISION OF FOOD AND DRUGS.

HERMANN C. LYTHGOE, *Director.*

Report of Division of Food and Drugs.

During the year 1918 the Food and Drug Division of the Massachusetts State Department of Health has been engaged in the usual routine work relative to the enforcement of the milk, food, drugs, cold storage and slaughtering laws, and in the examination of samples submitted by the police authorities, as well as in the manufacture of arsphenamine.

The new laboratory facilities have been completed after many delays. These delays seriously curtailed all food and drug research work, and also curtailed the manufacture of arsphenamine to a considerable extent.

There have been quite a few changes in the personnel of the Division during the past year. Mr. Charles H. Hickey, assistant analyst, resigned to accept an industrial position, and his place was filled by the permanent appointment of Mr. Howard D. Williams who was temporarily employed. Shortly after this Mr. Williams was inducted into the United States service, and his place was filled by the appointment of Miss Bernice H. Alderman. Mr. M. P. Crowe resigned his position as inspector, and his place was filled by the appointment of Mr. Arnold C. Perham. Dr. George L. Drury, during the latter part of the year, enlisted in the United States service as second lieutenant, Veterinary Corps. His place has not been filled, as undoubtedly he will be discharged from the United States service early during the coming year. Miss Celeste E. Macaulay, the chief stenographer, died during the influenza epidemic, and her place was filled by the promotion of Miss Eleanor J. Brogan. A new stenographer, Miss Anna E. Daley, is to be employed Dec. 1, 1918. In the manufacture of arsphenamine four male and three female laboratory assistants are now employed.

The Division has been very much handicapped by the distribution of funds in the last budget. More money than was necessary was appropriated for salaries, and the appropriation for expenses was insufficient. This means that the Division must return an unexpended balance at the close of the fiscal year. At the same time, we were obliged to curtail field work during the month of August and to practically cease this work on the 1st of September. Were it not for the fact that fifteen mileage books were on hand at the beginning of the fiscal year, the field work would have been discontinued much earlier.

It will be necessary to have considerably more money for the coming year, due first, to the increase in railroad rates; second, to increase in hotel rates; third, to increase in chemical and laboratory supplies; and fourth, to increase in the price of samples purchased by the inspectors.

Notwithstanding this deficiency in money, the Division materially increased its work over that during the previous year. A comparison of the work of the two years is given in the following table: —

	1918.	1917.
Milk samples,	7,738	7,060
Food samples,	2,142	1,704
Drug samples,	396	794
Samples submitted by police,	210	360
Total samples,	10,486	9,718
Prosecutions,	337	307
Fines imposed,	$8,143.10	$5,560.60
Confiscations,	87	124
Weight of confiscated articles (pounds),	157,557	305,000

The number of court cases, and particularly the fines, are much heavier. This is due, primarily, to the increased number of samples collected, but the heavy amount of fines is due to the exceptionally large fines imposed in a number of cases. The milk cases were naturally the most numerous, and, as usual, the increase in the price of milk seems to result in an increase in adulteration of milk.

There were prosecuted and convicted 14 cases for the sale of low standard milk; 13 cases for the sale of skimmed milk, 4 of which were dismissed for want of prosecution, and 9 of which were convicted; and there were 80 cases prosecuted for the sale of watered milk, of which 6 were discharged, 1 was dismissed for want of prosecution, and 1 on which sentence was suspended; the balance were convicted. There was 1 conviction for the sale of dirty milk, 2 convictions for misuse of milk bottles, 3 convictions for the sale of adulterated cream, and 2 convictions for the sale of low standard cream.

There were 54 cases for the sale of adulterated foods; 3 cases for the sale of adulterated honey; 4 cases for the sale of adulterated lard; 1 case for the sale of adulterated mince meat; 36 cases for the sale of adulterated olive oil; and 8 cases for the sale of adulterated sausages, resulting in conviction. One case involving salt cod fish was discharged. One case for the sale of watered scallops was discharged.

There were 20 cases for the sale of decomposed foods, of which 14 related to eggs; 2 to meat; and 2 to nuts, resulting in conviction. Two cases relating to meat were discharged.

For the sale of stale eggs as fresh eggs there were 7 convictions; 6 cases dismissed without finding, on payment of costs; and 1 case nol-prossed.

For violation of the cold-storage laws there were 101 cases, of which 96 were convicted and 5 discharged.

For violation of the slaughtering laws there were 13 cases, of which 10 were convicted and 3 discharged.

For the sale of adulterated drugs there were 19 cases, of which 18 were convicted and 1 nol-prossed.

Some of the court cases deserve special comment.

There were two cases tried in Adams, one for the stamping of a carcass which the inspector had not seen slaughtered, the other for the slaughtering of an animal in the absence of an inspector. The evidence involving both cases was identical. The court convicted one man and acquitted the other.

One case was tried for the sale of fish containing added fish bones. The United States Department of Agriculture furnished information in this case that the corporation in question was making salt fish to which about 30 per cent of fish bones were added. The analysis of the sample indicated that this evidence was correct. The court, however, declined to convict. This salt fish was finely ground up, and the bones could not be removed by the person who was preparing food from the article in question.

A case against the Armour Company was dismissed in the lower court on the ground that the Federal Food Administration had set aside the Massachusetts cold-storage law. One of the inspectors of this Department then obtained evidence of a number of technical violations on the part of Armour & Co., and the case was referred to the district attorney, who obtained an indictment. In these cases Armour had permission from the United States Food Administration to hold certain poultry in storage beyond the twelve months allowed by the Massachusetts law. The poultry was removed in from two to six weeks after the year had expired. A conviction was secured in this case in the Superior Court, and the Armour Company did not desire to carry the case to the Supreme Court. Under ordinary conditions this case would never have been put into court, but at that time it was essential to establish the standing of our cold-storage law with respect to the United States law.

Two cases of note were tried during the year, pertaining to violations of the slaughtering laws. The town of Rockland declined to appoint a slaughtering inspector. A man in that town killed two hogs

and then requested the former inspector to apply the official stamp. He was referred to the local board of health. The secretary of the board of health then gave the stamp to a man and told him to go to the market where these dressed hogs were and apply the stamp. A request was made to this Department to investigate the circumstances. One of the inspectors visited Rockland, found the hogs, found that they were not fit for food and confiscated them. The man who caused the hogs to be butchered and the man who did the stamping were summoned into court, pleaded guilty, and paid their fines.

A slaughtering case involving diseased meat was secured in Lowell. One of the inspectors found the hind quarter of a beef animal in a sausage factory. He did not like the appearance of the meat, and upon sticking a knife into it found that it was completely infiltrated with pus. The carcass bore the stamp of the town of Reading. Further investigation was made in Reading, and it appeared that the carcass came from a bull which had been lame for some time. The farmer who owned the bull sold him to the butcher who killed the animal on the farm and carried the carcass to the slaughterhouse. Subsequently, the inspector stamped the carcass. The inspector acknowledged stamping the carcass he had not seen killed. Inasmuch as this case covered the jurisdiction of two courts, an attempt was made to have the district attorney handle the matter before the grand jury, but he declined. We therefore took the sausage maker into court in Lowell for using diseased meat in the manufacture of food. He was convicted and fined. The other cases were taken into court in Woburn, and the butcher and inspector were both found not guilty. The court refused to allow the admission of a statement of conversation between the inspector and the butcher relative to the sale. Without this evidence it was impossible to convict. Relative to the inspector, the court held that the term "time of slaughter" meant any time from the actual killing of the animal to the application of the official stamp. This inspector has been convicted twice for violation of the slaughtering laws. He was disapproved by this Department because of these convictions, but upon receipt of a letter from the board of health that they guaranteed to remove him if any further irregularities were discovered, his disapproval was reconsidered and he was approved. After these cases were over the board of health was asked to live up to its agreement, which it declined to do.

A number of cases had been referred to the United States Department of Agriculture for violation of the food and drug law by shipping adulterated milk into Massachusetts. This procedure has been unsatisfactory, first, owing to the refusal of the Department to prosecute

certain cases, — specifically cases where the Massachusetts dealer went into the other State and acted as his own carrier; and second, because of twelve months' delay in their arriving at a decision relative to the advisability of prosecution. Four cases of this nature were obtained in the fall of 1917 and were referred directly to the United States attorney as per the United States foods and drugs act. The United States attorney for Vermont referred these cases to the United States Attorney-General, and subsequently informed the Department that the United States Attorney-General's office stated that there was no violation of the law. A few weeks ago, after this information was received, the matter was referred to the Attorney-General of this Commonwealth, who took the matter up with the office of the United States Attorney-General and secured a reversal of their decision. We were then summoned to appear before the Vermont grand jury. The cases were put on by the United States attorney and indictments secured in all instances. In all four cases the defendants pleaded guilty and paid fines of $50 each. The United States attorney stated that he sent the information to Washington merely for a ruling on the collection of evidence by State officers who were not United States officers, and he was rather surprised at the reply he received which was to the effect that no interstate shipment of milk had been made on the part of the defendants. He was thoroughly satisfied, however, that with the possible exception of authority to take samples, we had made out a perfect case. He was informed that in this instance we did not take the samples until they were ready for delivery to the Massachusetts milk dealer, and they were taken then with the consent of the Massachusetts dealer. The United States attorney was further informed that we realized that we had absolutely no right to go into New Hampshire and seize samples of foods intended for interstate shipment.

A number of other cases had been referred to the United States attorneys in Rhode Island and New York for violation of the milk law and for the shipment of adulterated maple sugar and of adulterated olive oil. The attorney for New York has referred all these cases to the United States Department of Agriculture, although the law says he shall act upon advice received from State Health Officers.

In one of these cases the United States attorney and the United States Department of Agriculture admit that we have made out a perfect case. Nevertheless, the United States attorney declines to prosecute because the New York dealer shipping the maple sugar into Massachusetts claims he did not know the sugar was adulterated, although he bought his sugar without a guarantee and bought it at a price lower than the market price for maple sugar.

The cases involving the interstate shipment of olive oil have not been reported on yet by the United States attorney. The United States attorney for Rhode Island has asked for affidavits on the cases submitted to him. These have been furnished, and the material will be used in preparing information for submission to the United States court in Rhode Island during the coming year.

Special investigations were made upon the sale of eggs. It was found that, in general, retail dealers were selling eggs of all descriptions as fresh eggs. The false advertising law was used successfully in curbing violations of this character. In one instance a store keeper was found to be buying but one grade of cold-storage eggs, and was putting these eggs out at various prices because some of his customers did not care to buy cheap eggs but desired high-priced eggs. In two instances of this character the dealers were fined $200, primarily because they were aliens of draft age, one of whom was an alien enemy. These cases were appealed, and the district attorney supported the justice of the lower court in his contention that the fines in these instances should be excessive.

The confiscations were much less than those reported last year. This was in some measure due to the increased cost in foodstuffs, and possibly due to the fear, on the part of dealers, of the regulations of the Food Administration, which imposed severe penalties upon anybody who wasted food. The railroads were the greatest offenders in this respect. In one instance an inspector of this Department was called upon to confiscate a carload of smelts which was one month in shipment from the Pacific coast. This represented 25,000 pounds of good food which never should have been wasted.

The following is a summary of the confiscated articles: —

Articles in Cold Storage condemned upon Physical and Chemical Examinations as Unfit for Food.

Articles.	Number of Confiscations.	Weight (Pounds).
Eggs, case,	1	4[1]
Eggs, frozen,	3	3,610
Butter,	1	620
Poultry,	11	1,440
Game,	1	10
Meat, fresh, and meat products, fresh,	17	62,475
Fish, fresh food,	3	25,277
Totals,	37	93,432[2]

[1] Cases. [2] Also 4 cases.

Articles in Stores, Markets and Sausage Factories condemned upon Physical and Chemical Examinations as Unfit for Food.

Articles.	Number of Confiscations.	Weight (Pounds).
Eggs,	1	315
Poultry,	3	45½
Venison,	1	75
Meat, fresh, and meat products, fresh,	39	6,222½
Fish,	4	55,387
Grapes,	1	2,128[1]
Totals,	49	62,045[2]

Articles in Slaughterhouses condemned upon Physical and Chemical Examinations as Unfit for Food.

Meat,	11	1,960

[1] Packages. [2] Also 2,128 packages.

The new food and drug law of 1917, which superseded our former food and drug law, and which was passed largely through the instrumentality of the Boston Chamber of Commerce, went into effect upon May 1 of the present year. This law was somewhat criticised in the report of last year, but it has not yet been in operation for a sufficient length of time to ascertain its defects, as there have been but very few contests over the cases which have been tried. One contested case recently tried was lost notwithstanding the fact that the Department had complied as closely as possible with all the technical details which the law contains for the protection of the dealers. The lawyer who defended the case told the assistant analyst that in his opinion the law was inoperative if properly defended, and advised against its use by the Department. The judge who heard the case said that the law was not intended for the protection of the public from the sale of adulterated foods, but that it certainly gave the dealer all the opportunity to escape from its penalties by reason of the technical objections placed in the opposition of the prosecution.

It is inadvisable to try to correct this law at the coming legislative session, as there are undoubtedly many so-called jokers existing therein which will be discovered from time to time.

This law provides for the adoption of regulations by this Department. It has been impossible to do this, owing to the absence of

sufficient funds to print and distribute any regulations which may be adopted. This, however, must be done shortly after the opening of the next fiscal year, attempting wherever possible in these regulations to correct some of the technical defects which have become apparent.

There have been collected and examined 7,738 samples of milk, of which 7,617 were collected by the inspectors. Of these samples, 2,249 contained less than the 12 per cent of solids required by law, and included 24 samples of skimmed milk sold as such, 172 samples of skimmed milk sold as pure milk, and 424 samples containing added water. There were 3 samples of milk containing sufficient dirt to be considered adulterated. Of the 6,539 samples obtained from milk dealers, 212 were watered and 164 were skimmed, and not so labeled. Wherever possible each instance of adulteration was thoroughly investigated, which resulted in the collection of 1,043 samples of milk from suspected producers, of which 198 samples were watered and 3 were skimmed. Of the samples collected from suspected producers, 63 were obtained outside of the State.

A campaign was waged against restaurants, owing to the practice of serving skimmed milk to their customers. A letter was sent to local milk inspectors, informing them that it was the intention of the Division to prosecute restaurant keepers wherever skimmed milk was served, without first giving a warning as had been the previous custom. Some local inspectors notified the restaurants under their jurisdiction of this proposed action, and in some instances copies of the letter were published in local newspapers. This action resulted in some improvement in the restaurant situation. There is still room, however, for more improvement in this line.

Notwithstanding the increase in the cost of milk, and the fact that the price to the farmer is based upon the fat content, there has been a reduction in the average quality of milk sold throughout the State. For the past ten years the Division has computed the composition of the average milk samples collected, exclusive of those which could be declared skimmed or watered. By this means we can arrive at an approximation of the quality of milk sold throughout the State. The composition of the average milk, exclusive of adulterated milk sold in the State during the past ten years, is shown in the following table: —

Year.	Number of Samples.	Solids (Per Cent).	Fat (Per Cent).	Solids not Fat (Per Cent).
1909,	4,242	12.78	4.10	8.68
1910,	5,032	12.85	4.02	8.83
1911,	4,341	12.83	4.00	8.83
1912,	4,516	12.66	3.89	8.77
1913,	6,154	12.69	3.84	8.85
1914,	5,502	12.70	3.82	9.88
1915,	6,765	12.68	3.82	8.86
1916,	7,458	12.66	3.72	8.94
1917,	6,317	12.53	3.73	8.80
1918,	6,995	12.47	3.76	8.71

Investigations of the character of ice cream sold indicated that while the percentage of fat corresponded in general to the requirements of the law, the samples brought in by the inspectors were much smaller in quantity than during the previous years. Further investigation revealed that this was due to the introduction of large amounts of air during the process of manufacture. This introduction of air is highly profitable, since ice cream is sold by volume and not by weight, and air is naturally much cheaper than the other ingredients of ice cream. Several one-half pint samples were obtained and these were weighed; 5 samples varied in weight from 105 to 165 grams; 5 samples varied from 175 to 215 grams; and 2 samples weighed 250 and 265 grams, respectively. There were very few samples below the standard. Only 4 of the 269 collected contained less than 7 per cent of fat. All these samples were made by persons operating small stores. These people were unfamiliar with the law and had made their ice cream from milk. Warnings were given in all instances of this nature.

The district attorney of Middlesex County asked for information relative to the character of the water used in ice-cream parlors and at soda fountains, in which the scoops were allowed to stand when not in use. Since the Department did not possess any information upon this subject, an investigation was made during September, and it was found that the water was unusually clean bacteriologically, and was by no means as bad as its physical appearance would lead one to believe. It was found that in many cases the water was changed several times per day. The samples were all taken during warm weather, when the conditions would naturally be as bad as possible. A summary of the results obtained is as follows: —

Five samples contained from 0 to 1,000 bacteria per cubic centimeter, with an average bacteria content of 71 per cubic centimeter.

Ten samples contained between 1,000 and 10,000 bacteria per cubic centimeter, with an average bacteria content of 4,645 per cubic centimeter.

Nine samples contained from 10,000 to 56,700 bacteria per cubic centimeter, with an average bacteria content of 21,139 per cubic centimeter.

The average of all the samples was 11,737 bacteria per cubic centimeter.

In those cities and towns where regulations relative to the bacteria content of ice cream have been made, a maximum limit of 500,000 bacteria per cubic centimeter has been set. None of these samples of wash water approached that limit, and the average was considerably below.

There were collected and examined 2,143 samples of foods, of which 588 were adulterated. Many of these samples reported adulterated, such as fish, meat and condensed milk, were not purchased on the market, but were taken for analysis as a preliminary to confiscations.

The Food Administration submitted a number of samples of butter, canned goods, cereals, cocoa, crackers, confectionery, fish, gum, jellies and peanut butter to be examined for the presence of poisons. All of these samples were submitted to the Food Administration by the general public, and, needless to state, nothing deleterious was found.

The United States Army submitted samples of soft drinks, cattle feed and other samples, including one of intestinal fluid obtained during an autopsy. We declined to examine the latter specimen, but all the others were examined and reports were sent to the army.

The Adjutant-General's office submitted a number of specimens, the analyses of which were of alleged military value. Nothing unusual, however, was found in any of these specimens.

The public submitted a number of samples said to be poisonous, or to have caused sickness, or to have contained ground glass. Nothing unusual was found in any of these samples.

Local inspectors submitted six specimens for pathological examination, only one of which was such that the carcass in question could be passed for food purposes.

The Food Administration, desiring to enforce the regulations as to the use of substitute flours in bakehouses, conferred with the Division relative to making examinations of bread samples. It was assumed that a number of samples would be submitted, but no requests for examination were received and no samples were submitted. In anticipation of this possible request, considerable research work was carried on to ascertain whether or not the percentage of substitutes in the

bread could be detected after baking. We were unable to obtain any satisfactory methods other than the usual method of making microscopic examinations of the dough before baking.

Of the adulterated samples not discussed elsewhere, one was a sample of oleomargarine submitted by a local milk inspector; one was a sample of renovated butter; 1 was a sample of butter high in water; and 3 were samples of rancid butter. The adulterated samples of clams, oysters and scallops were watered. The adulterated samples of cider, mince meat, soft drinks and hamburg steak contained preservatives. The adulterated samples of canned goods, condensed milk, candy, fish, beef, veal, pork, some of the sausages, nuts and shrimp were decomposed. The balance of the sausages contained starch or vegetable material in excess of 2 per cent. The single adulterated sample of peanut butter contained about 1 per cent of grit. An inspection of the factory, however, indicated that all necessary precautions were taken to insure a clean product. It occasionally happened that a small stone about the size of a peanut managed to get through the various cleaning processes, and naturally was ground up with the peanuts. The vinegar samples reported adulterated were somewhat low in acetic acid.

One of the inspectors, carrying out some work for another Division, found a large amount of sugar stored away in a barroom. The proprietor said he did not know the nature of the material or who owned it. The inspector took samples, the samples were examined, and the information turned over to the Food Administration. The Food Administration seized the sugar. When this information was published in the papers by the Food Administration, the report stated that the information was received from the County Food Administrator.

The drug samples examined were much less than those of previous years, due entirely to the smallness of our appropriation. It was deemed inexpedient to spend more money than was absolutely necessary upon the purchase of these samples. In all, 396 samples were examined, of which 126 were adulterated. No unusual adulterants were detected.

A number of attempts were made to utilize the misbranding provisions of the new food and drug law in cases pertaining to the sale of patent medicines. These medicines, however, are so cleverly labeled that it is practically impossible to maintain a case of any sort against any person selling them. One remedy, however, the B. & M. Remedy for Tuberculosis, apparently was a violation of this law. This remedy pretends to absolutely cure tuberculosis and various other diseases, and its analysis showed it to consist of an emulsion of turpentine, ammonia,

water and egg white. A small amount of carbolic acid was found in one of these samples. The proprietor of this remedy, however, is without any doubt absolutely honest in his belief that the remedy can effect the cure which he claims, and under no circumstances could he be convicted of fraud in connection with the sale of this remedy. Therefore no prosecution could be undertaken.

The cold-storage warehouses have been inspected as usual, and the conditions, in general, have been found to be satisfactory. As would naturally be expected, there has been a considerable increase in the storage of goods in this State. This is largely due to war conditions, as we are shipping food to Europe not only for the civilian population, but also for the 2,000,000 soldiers which we have "over there." The food intended for export shipment is sent from Chicago to Albany, and is there held until it is known from where it will be shipped. Then it is sent to either Boston or New York, as the case may be, and held until placed on board the vessel for shipment. The result of this condition represents tremendous amounts placed in storage, but the holdings of butter and eggs reported do not indicate any unusual amount of goods on hand.

Table 1 gives a summary of the monthly reports of the cold-storage warehouses, showing articles placed in storage, and eggs and butter on hand.

The following table, compiled from the reports submitted since the storage law went into effect in this State, gives an idea of the increase in storage in this State. The great increase has been in meat and fish, both of which are no doubt due to the export of these articles. The storage of butter, poultry and eggs has been fairly uniform throughout all these years.

Articles in Cold Storage.

	1913.	1914.	1915.	1916.	1917.	1918.
Eggs, case (million dozens), . .	23.9	21.6	26.0	20.9	22.9	25.0
Butter (million pounds), . .	28.3	32.1	38.5	35.8	36.7	37.9
Poultry (million pounds), . .	9.8	14.6	16.8	15.5	9.8	16.3
Meat (million pounds), . .	14.2	26.1	47.2	51.8	63.2	115.4
Fish (million pounds), . . .	17.8	22.4	27.0	31.8	45.9	51.9

The number of extensions granted on goods in cold storage is less than last year. Only 162 extensions were granted. The total weight of the goods covered by these extensions is 570,640 pounds, which

represents 0.23 per cent of the total goods placed in storage. By far the most of this was beef purchased under contract by the allied governments and held for shipment. In 132 instances goods were ordered out of storage at the close of the twelve months permitted by law. In 1917 but 40 lots were ordered out at the close of a year's storage. In 32 instances extensions were refused. Forty requests for permission to remove articles which had been in storage for longer than twelve months were granted.

Tables 2, 3, 4 and 5 give the details of the cold-storage extensions.

In acting upon these extensions the Division was to a considerable extent influenced by the attitude of the Food Administration. Extensions on poultry and frozen eggs were given in accordance with written communications from the Food Administration. These represented the largest excessive storage of articles intended for domestic consumption.

The extensions on poultry were made in accordance with a request received prior to the beginning of the fiscal year. Owing to the sugar shortage, it was evident that egg whites in storage could not be used for food purposes, as they are used almost exclusively by bakers in making frostings. The Food Administration was therefore requested by this Division to give an opinion relative to the extensions which should be allowed on frozen egg whites. We were verbally informed to grant these extensions until the 1st of August, and the extensions were therefore granted in accordance with this suggestion. The holders of the eggs protested, and were advised to carry their protests to the Food Administration because our action was based upon advice received from that source. As the result of this protest we were requested in writing to grant these extensions until the 1st of November, to which request we rigidly adhered. Later we were requested in writing to increase these extensions until the first day of January. This was done. It should be understood in this respect that all these extensions are illegal at present. The United States Food Administration law prohibits the hoarding of food, and the regulations of the Food Administration define hoarding as "the holding of food longer than over the period of scant or no production." It is evident, therefore, that the holding of food in storage for more than twelve months is a direct violation of the Food Administration law. The granting of additional time on extensions is not permitted by our State law. Under these circumstances, this Department was obliged to violate both of these laws and permit this food to remain in storage, which could not be used at that time, and if removed from storage would have deteriorated and would have been destroyed.

The conditions under which slaughtering is carried on, while far

from being satisfactory, are much better than those of former years. The change in the laws, enacted two years ago, which permits a person not engaged in the slaughtering business to slaughter his own animals for his own use without inspection, has caused more or less trouble, and this law should be amended to require all slaughtered animals to be inspected.

Some persons, on ascertaining that the carcass was to be confiscated, have informed the inspector that they would take the carcass home and eat it themselves, and one or two reports were made of threats to local inspectors if they confiscated the carcasses. In one instance a man broke into the slaughterhouse and carried off the carcass before a representative from the rendering company had arrived. Reports have been received that persons have slaughtered hogs without inspection, as they had a right, but that they had salted the pork and subsequently sold the pork to stores. This is a difficult matter to control under present conditions.

A summary of the inspectors' reports of the number of carcasses inspected and confiscated during the year shows a great decrease when compared with the 1917 figures. Somewhat over 30,000 less carcasses were inspected this year, or about 1,000 cattle, 12,000 calves and 16,000 hogs. It does not appear that there could be such a decrease in slaughtering, and probably the killing without inspection, as provided for in the statutes, accounts, to a considerable degree, for the apparent diminution in slaughtering. The confiscated carcasses bear about the usual relation to the total number of carcasses inspected, and the diseases for which the carcasses were confiscated are at present in about the same proportion as in former years, tuberculosis in cattle and hogs, immaturity in calves, and hog cholera in hogs being responsible for 83 per cent of the total confiscations.

In the manufacture of arsphenamine it was found necessary to change the process, and by this change we have been able to increase the yield of finished product at less labor and to produce a product of less toxicity. In the process described last year each of the intermediate products was repurified. In the process used at present only one of the products needs to be repurified.

The United States Public Health Service has increased the requirements, but our product has been able to keep step with all these increases. It appears that this requirement will be again increased when it will be necessary to repurify one of the intermediate products, which will result in a slight delay in time and possibly in a small loss of substance. A large glass-lined tank with stirring and heating apparatus has been installed for the manufacture of arsanilic acid. A dis-

tilling apparatus has been designed and installed for the recovery of aniline and of alcohol. There was an enormous delay in the installation of this material, which led to practically three months of inactivity in this work. At present, apparently there will be no delay in the manufacture of this drug during the coming year.

During the past year 2,936 doses of arsphenamine have been made and distributed. Of this number, 994 were made during November. The rate of production during the coming year will probably be in the neighborhood of 2,500 doses during December, and 4,000 doses during January.

The Division is working under very adverse conditions in making arsphenamine, principally because of insufficiency of space and because of the unavailability of the space at our disposal. For carrying out this work in very large quantities, such as the commercial houses undertake, where several shifts of men are employed, we should have special laboratories devoted to this work alone. There should be one room devoted to the manufacture of arsanilic acid; another room devoted to the manufacture of other intermediates; a third room for the manufacture of the final product; and a fourth room for bottling. At present all the manufacturing is done in one room. The bottling is done in the office, and a portion of the manufacturing work, namely, the preparation of absolute alcohol and absolute ether, is done in a portion of the office of the Director of the Division.

One interesting feature of this work is the reduction in price offered by the commercial houses who desire to sell this article to us for the use of our clinics. The prices have been slowly coming down. No doubt, if the Department were to cease manufacturing the prices would promptly increase.

Because of the termination of hostilities, the patent question is now becoming serious. In all probability a suit will be brought against the Federal Trade Commission for the royalties which would have accrued under the patent, provided the Germans had been able to get the article upon the United States market. If it is impossible to break the patent, these royalties must undoubtedly be paid. We have not undertaken to secure a license from the Federal Trade Commission, principally because of the expense in securing such license, which is $100 for each patent. There are, in all, five patents to be covered. It may, however, be advisable to secure such a license during the coming year.

Cold Storage Statistics.

Table 1. — *Articles placed in Cold Storage from Dec. 1, 1917, to Dec. 1, 1918.*

Articles placed in Cold Storage.	December, 1917.	January, 1918.	February, 1918.	March, 1918.	April, 1918.	May, 1918.	June, 1918.	July, 1918.	August, 1918.	September, 1918.	October, 1918.	November, 1918.	Totals.
Eggs, case (dozens),	120,063	33,960	127,770	398,586	8,049,683	8,408,073	3,488,920½	1,313,608	940,718	782,211	959,590	406,050	25,029,232½
Eggs, broken out (pounds).	187,164	192,100	136,519	163,241	115,971	273,556	263,958	278,972	242,800	128,852	214,011	180,439	2,377,583
Butter (pounds),	538,108	280,245	662,321	1,796,715	915,049½	766,814½	8,011,148	10,314,014	5,505,407	2,547,106	3,294,634	3,236,785	37,868,347
Poultry (pounds),	1,543,737	3,343,352	1,967,102	999,950	255,498	779,025½	854,840	922,207	799,038	705,118	1,119,135	2,965,025	16,254,027½
Game (pounds),	7,586	1,060	1,550	4,812	612	242	115	662	746	1,422	7,782	13,415	40,004
Meat, fresh, and meat products, fresh (pounds).	8,421,135	6,542,943	5,329,232	10,327,867	14,464,592	19,158,740	7,410,552	8,051,962	9,713,360	6,296,167	9,866,661	9,780,602	115,363,813
Fish, fresh food (pounds),	1,716,365	2,171,379	2,106,043	4,071,101	5,184,534	7,159,940	8,415,207	7,127,278	4,733,032	2,343,028	3,905,524	2,973,887	51,907,318
Totals,	12,534,158	12,565,039	10,330,537	17,762,272	28,985,939½	36,546,391	28,444,740½	28,008,703	21,935,101	12,803,904	19,367,337	19,556,203	248,840,325

Butter and Eggs held in Cold Storage from Jan. 1, 1918, through Dec. 1, 1918.

Articles held in Cold Storage.	Jan. 1, 1918.	Feb. 1, 1918.	Mar. 1, 1918.	Apr. 1, 1918.	May 1, 1918.	June 1, 1918.	July 1, 1918.	Aug. 1, 1918.	Sept. 1, 1918.	Oct. 1, 1918.	Nov. 1, 1918.	Dec. 1, 1918.
Eggs, case (dozens),	5,212,755	1,218,757	40,950	192,420	8,021,064	16,047,336	18,883,611	18,692,031	17,763,681	16,369,697	13,047,600	9,003,143
Eggs, broken out (pounds),	554,689	402,032	442,446	426,896	410,576	432,609	535,767	642,372	569,701	499,232	418,312	327,007
Butter (pounds),	11,428,644	6,600,650	3,752,997	2,966,526	1,828,981½	798,242	8,063,252	16,114,385	18,876,072	17,508,065½	16,375,372	14,248,021
Totals,	17,196,088	8,221,439	4,236,393	3,585,842	10,260,621½	17,278,187	27,482,630	35,448,788	37,209,454	34,376,994½	29,841,284	23,578,171

TABLE 2. — *Summary.*

Requests for extension of time granted,	162
Eggs,	32
Butter,	12
Poultry,	93
Game,	2
Meat,	13
Fish,	10
Requests for extension of time not granted,	32
Eggs,	1
Butter,	6
Poultry,	15
Meat,	8
Fish,	2
Requests for permission to remove granted,	40
Eggs,	3
Butter,	7
Poultry,	19
Game,	3
Fish,	8
Articles ordered removed from storage (no request made),	129
Eggs,	2
Butter,	10
Poultry,	39
Game,	4
Meat,	54
Fish,	20

TABLE 3. — *Requests for Extension of Time granted from Dec. 1, 1917, to Dec. 1, 1918, on Goods in Cold Storage.*

[Reason for such extension being that goods were in proper condition for further storage.]

ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Eggs, canned,	5,940	July 14, 1917	Aug. 1, 1918[1]	Poole, J. R., Company.
Eggs, canned,	4,020	July 14, 1917	Nov. 1, 1918[1]	Poole, J. R., Company.
Eggs, canned,	2,040	Aug. 4, 1917	Nov. 1, 1918[1]	Poole, J. R., Company.
Eggs, frozen,	330	May 4, 1917	June 20, 1918	Green & Co.
Eggs, frozen,	600	May 5, 1917	June 20, 1918	Green & Co.
Eggs, frozen,	675	May 7, 1917	June 20, 1918	Green & Co.
Egg whites, frozen,	990	May 3, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen,	1,680	May 10, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen,	660	May 12, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen,	540	May 14, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen,	930	May 15, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen,	990	May 16, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.

[1] Extension granted to this date in accordance with request from the Food Administration.

TABLE 3. — *Requests for Extension of Time granted from Dec. 1, 1917, to Dec. 1, 1918, on Goods in Cold Storage* — Continued.

ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Egg whites, frozen, .	330	May 17, 1917	Jan. 1, 1919	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	1,290	May 18, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	1,080	May 21, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	1,050	May 22, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	330	May 23, 1917	Jan. 1, 1919	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	960	May 24, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	780	May 28, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	840	June 7, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	960	June 8, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	840	June 11, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	900	June 13, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	870	June 14, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	585	June 15, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	870	June 19, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	1,290	June 20, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	1,230	June 21, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	2,400	June 22, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	570	June 23, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	1,530	June 25, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Egg whites, frozen, .	780	June 27, 1917	Jan. 1, 1919[1]	Goldsmith-Wall-Stockwell Company.
Butter, ...	100	May 28, 1917	Dec. 28, 1918	Cutter, George F.
Butter, ...	120	June 11, 1917	Sept. 15, 1918	Fowle, Hibbard Company.
Butter, ...	180	June 11, 1917	Sept. 15, 1918	Fowle, Hibbard Company.
Butter, ...	120	July 24, 1917	Nov. 1, 1918	Industrial School for Crippled and Deformed Children.
Butter, ...	671	May 7, 1917	Sept. 1, 1918	Lewis, Mears Company.
Butter, ...	308	July 12, 1917	Oct. 15, 1918	Normal Hall, Plymouth, N. H.
Butter, ...	1,140	Aug. 14, 1917	Nov. 1, 1918	Richardson, Harry T. B.
Butter, ...	2,400	July 2, 1917	Dec. 1, 1918	St. John's Preparatory School.
Butter, ...	1,080	July 2, 1917	Dec. 1, 1918	St. John's Preparatory School.
Butter, ...	360	Aug. 14, 1917	Sept. 14, 1918	Wilfert, George H., & Co.
Butter, ...	1,200	July 27, 1917	Jan. 27, 1919	Worcester Market.
Butterine, . . .	180	Aug., 1917	Sept. 14, 1918	Union Training School.
Broilers, ...	98	Dec. 2, 1916	Jan. 2, 1918	Borst, Pierce Company.
Broilers, ...	483	Dec. 2, 1916	Jan. 2, 1918	Borst, Pierce Company.
Broilers, ...	653	Dec. 2, 1916	Apr. 2, 1918	Borst, Pierce Company.

[1] Extension granted to this date in accordance with request of Food Administration.

TABLE 3. — *Requests for Extension of Time granted from Dec. 1, 1917, to Dec. 1, 1918, on Goods in Cold Storage* — Continued.

ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Broilers, ...	166	Dec. 2, 1916	Jan. 2, 1918	Borst, Pierce Company.
Broilers, ...	456	Dec. 11, 1916	Jan. 11, 1918	Borst, Pierce Company.
Broilers, ...	954	Dec. 11, 1916	Jan. 11, 1918	Borst, Pierce Company.
Broilers, ...	65	Dec. 26, 1916	Jan. 26, 1918	Borst, Pierce Company.
Broilers, ...	67	Dec. 26, 1916	Jan. 26, 1918	Borst, Pierce Company.
Broilers, ...	222	Dec. 26, 1916	Jan. 26, 1918	Borst, Pierce Company.
Broilers, ...	486	Dec. 26, 1916	Jan. 26, 1918	Borst, Pierce Company.
Broilers, ...	498	Jan. 3, 1917	Feb. 3, 1918	Borst, Pierce Company.
Broilers, ...	328	Jan. 13, 1917	Feb. 13, 1918	Borst, Pierce Company.
Broilers, ...	219	Jan. 13, 1917	Feb. 13, 1918	Borst, Pierce Company.
Broilers, ...	1,083	Jan. 13, 1917	Feb. 13, 1918	Borst, Pierce Company.
Broilers, ...	140	Jan. 3, 1917	Apr. 3, 1918	Borst, Pierce Company.
Broilers, ...	361	Jan. 3, 1917	Apr. 3, 1918	Borst, Pierce Company.
Broilers, ...	264	Dec. 11, 1916	Apr. 11, 1918	Borst, Pierce Company.
Broilers, ...	222	Dec. 11, 1916	Apr. 11, 1918	Borst, Pierce Company.
Broilers, ...	226	Dec. 11, 1916	Apr. 11, 1918	Borst, Pierce Company.
Broilers, ...	309	Dec. 26, 1916	Apr. 26, 1918	Borst, Pierce Company.
Broilers, ...	790	Dec. 26, 1916	Apr. 26, 1918	Borst, Pierce Company.
Broilers, ...	270	Oct. 13, 1916	Mar. 19, 1918	Eastman, Frank B.
Broilers, ...	280	Oct. 13, 1916	Mar. 19, 1918	Eastman, Frank B.
Broilers, ...	156	Dec. 5, 1916	Jan. 1, 1918	Radlo Brothers Company.
Broilers, ...	332	Dec. 5, 1916	Jan. 1, 1918	Radlo Brothers Company.
Broilers, ...	195	Dec. 6, 1916	Jan. 1, 1918	Radlo Brothers Company.
Broilers, ...	926	Dec. 30, 1916	Feb. 1, 1918	Radlo Brothers Company.
Broilers, ...	734	Nov., 1916	Apr. 23, 1918	Robbins, Nathan Company.
Broilers, ...	2,003	Nov., 1916	Apr. 23, 1918	Robbins, Nathan Company.
Broilers, ...	3,517	Nov., 1916	May 15, 1918	Robbins, Nathan Company.
Capons, ...	153	Dec. 16, 1916	Apr. 16, 1918	Borst, Pierce Company.
Capons, ...	1,932	Feb. 13, 1917	Mar. 13, 1918	Lamson & Co.
Capons, ...	450	Feb. 17, 1917	Mar. 17, 1918	Lamson & Co.
Capons, ...	2,306	Mar. 2, 1917	Apr. 2, 1918	Lamson & Co.
Capons, ...	1,800	Feb. 17, 1917	June 17, 1918	Lamson & Co.
Capons, ...	1,677	Feb. 23, 1917	June 23, 1918	Lamson & Co.
Capons, ...	1,312	Feb. 26, 1917	June 26, 1918	Lamson & Co.
Capons, ...	3,333	Feb. 9, 1917	Mar. 9, 1918	Legg, G. M. D., Company.
Capons, ...	4,354	Feb. 12, 1917	June 12, 1918	Legg, G. M. D., Company.

TABLE 3. — *Requests for Extension of Time granted from Dec. 1, 1917, to Dec. 1, 1918, on Goods in Cold Storage* — Continued.

ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Capons,	740	Jan. 27, 1917	Mar. 1, 1918	Radlo Brothers Company.
Capons,	3,852	Jan. 29, 1917	Mar. 1, 1918	Radlo Brothers Company.
Capons,	1,713	Feb. 2, 1917	June 2, 1918	Wilcox, Charles A., & Co.
Chickens,	1,571	Dec. 11, 1916	Jan. 11, 1918	Borst, Pierce Company.
Chickens,	1,979	Dec. 11, 1916	Jan. 11, 1918	Borst, Pierce Company.
Chickens,	471	Dec. 26, 1916	Jan. 26, 1918	Borst, Pierce Company.
Chickens,	4,418	Dec. 11, 1916	Apr. 11, 1918	Borst, Pierce Company.
Chickens,	4,418	Dec. 26, 1916	Apr. 26, 1918	Borst, Pierce Company.
Chickens,	2,739	Dec. 26, 1916	Jan. 26, 1918	Borst, Pierce Company.
Chickens,	420	Jan. 11, 1917	Feb. 3, 1918	Borst, Pierce Company.
Chickens,	994	Jan. 13, 1917	Feb. 13, 1918	Borst, Pierce Company.
Chickens,	2,253	Jan. 13, 1917	May 13, 1918	Borst, Pierce Company.
Chickens,	696	Feb. 15, 1917	Mar. 27, 1918	Brockton Public Market.
Chickens,	576	Feb. 15, 1917	Mar. 27, 1918	Brockton Public Market.
Chickens,	355	Dec. 29, 1916	Jan. 29, 1918	Corwin, C. R., Company.
Chickens,	410	Dec. 29, 1916	Apr. 4, 1918	Corwin, C. R., Company.
Chickens,	30	Nov. 10, 1917	Jan. 10, 1919	Croker, Joseph B.
Chickens,	581	Dec. 2, 1916	Feb. 1, 1918	Radlo Brothers Company.
Chickens,	1,028	Dec. 2, 1916	Jan. 1, 1918	Radlo Brothers Company.
Chickens,	840	Dec. 11, 1916	Feb. 11, 1918	Wilcox, Charles A., Company.
Chickens,	440	Dec. 11, 1916	Feb. 11, 1918	Wilcox, Charles A., Company.
Chickens,	886	Dec. 11, 1916	Feb. 11, 1918	Wilcox, Charles A., Company.
Chickens,	2,332	Dec. 22, 1916	Mar. 22, 1918	Wilcox, Charles A., Company.
Chickens,	1,378	Jan. 2, 1917	Apr. 2, 1918	Wilcox, Charles A., Company.
Chickens (Guinea),	991	Dec. 2, 1916	Apr. 2, 1918	Batchelder & Snyder Company.
Chickens (Guinea),	700	Jan. 10, 1917	Mar. 1, 1918	Dorr, Arthur E., & Co., Inc.
Chickens (Guinea),	2,843	Dec. 14, 1916	Apr. 14, 1918	Wilcox, Charles A., Company.
Chickens (Guinea),	554	Feb. 1, 1917	Mar. 1, 1918	Wilcox, Charles A., Company.
Fowl,	688	Dec. 2, 1916	Jan. 2, 1918	Borst, Pierce Company.
Fowl,	1,000	Dec. 2, 1916	Apr. 2, 1918	Borst, Pierce Company.
Fowl,	204	Dec. 11, 1916	Jan. 11, 1918	Borst, Pierce Company.
Fowl,	104	Dec. 26, 1916	Jan. 26, 1918	Borst, Pierce Company.
Fowl,	778	Jan. 3, 1917	Apr. 3, 1918	Borst, Pierce Company.
Fowl,	287	Jan. 13, 1917	Feb. 13, 1918	Borst, Pierce Company.
Fowl,	630	Nov. 23, 1916	Apr. 10, 1918	Brockton Public Market.
Fowl,	35	Nov. 23, 1916	Apr. 10, 1918	Brockton Public Market.

TABLE 3. — *Requests for Extension of Time granted from Dec. 1, 1917, to Dec. 1, 1918, on Goods in Cold Storage* — Continued.

ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Fowl,	48	Nov. 23, 1916	Apr. 10, 1918	Brockton Public Market.
Geese, green,	1,030	Dec. 4, 1916	Jan. 4, 1918	Robbins, Nathan, Company.
Geese, green,	976	Dec. 26, 1916	Jan. 26, 1918	Robbins, Nathan, Company.
Geese, green,	3,485	Dec. 11, 1916	Apr. 4, 1918	Robbins, Nathan, Company.
Poultry,	1,140	Dec. 4, 1916	Apr. 1, 1918	Malatesta, Joseph.
Poultry,	1,143	Dec. 2, 1916	Feb. 1, 1918	Radlo Brothers Company.
Poultry,	697	Dec. 22, 1916	Feb. 1, 1918	Radlo Brothers Company.
Poultry,	204	Dec. 23, 1916	Feb. 1, 1918	Radlo Brothers Company.
Poultry,	225	Nov. 26, 1916	Dec. 28, 1917	Soracco, T., & Co.
Poultry,	400	Dec. 2, 1916	Jan. 2, 1918	Soracco, T., & Co.
Poultry,	44	Dec. 2, 1916	Dec. 28, 1917	Soracco, T., & Co.
Poultry,	629	Nov. 23, 1916	Apr. 1, 1918	Wilfert, George H., & Co.
Turkeys,	4,057	Dec. 5, 1916	Dec. 20, 1917	Borst, Pierce Company.
Turkeys,	1,330	Dec. 1, 1916	Jan. 1, 1918	Handy, H. L., Company.
Turkeys,	1,320	Dec. 1, 1916	Jan. 1, 1918	Handy, H. L., Company.
Turkeys,	390	Dec. 1, 1916	Jan. 1, 1918	Handy, H. L., Company.
Turkeys,	784	Dec. 1, 1916	Jan. 1, 1918	Stevens, Genery, & Sons.
Squab,	450	Jan. 8, 1917	Mar. 8, 1918	Wilcox, Charles A., Company.
Deer,	125	Nov. 12, 1917	Jan. 12, 1919	Faust, H. M.
Rabbits,	8,300	Oct. 22, 1917	Dec. 22, 1918	Samuel Holmes, Inc.
Beef, frozen,	375,000	Nov. 23, 1917	Feb. 5, 1919	Burns, P., & Co., Ltd.
Beef chucks,	440	Unknown.	Sept. 16, 1918	Eastern Cold Storage Company.
Beef, Hamburg,	75	Aug. 25, 1917	Sept. 16, 1918	Eastern Cold Storage Company.
Beef livers,	2,648	Sept. 21, 1917	Oct. 21, 1918	Baker Brokerage Company.
Beef tongues,	14,568	July 1, 1917	Sept. 1, 1918	Chamberlain & Co.
Lamb,	56	June 20, 1917	Sept. 16, 1918	Eastern Cold Storage Company.
Lamb,	100	July 31, 1917	Aug. 31, 1918	Harvard Provision Company.
Lamb fores,	3,142	Oct. 23, 1917	Dec. 23, 1918	Dorr, Arthur E., & Co., Inc.
Mutton,	120	June 11, 1917	Sept. 16, 1918	Eastern Cold Storage Company.
Pork,	25	July 27, 1917	Sept. 16, 1918	Eastern Cold Storage Company.
Sausage,	25	Aug. 21, 1917	Sept. 16, 1918	Eastern Cold Storage Company.
Sweetbreads,	45	Unknown.	Sept. 16, 1918	Eastern Cold Storage Company.
Veal,	100	Aug. 10, 1917	Sept. 16, 1918	Eastern Cold Storage Company.
Lobster,	100	June 5, 1917	June 25, 1918	Commonwealth Ice and Cold Storage Company.
Salmon,	13,200	Jan. 4, 1917	Feb. 8, 1918	Booth Fisheries Company.
Smelts,	1,800	Nov. 6, 1917	Jan. 6, 1919	Foley, M. F., Company.

TABLE 3. — *Requests for Extension of Time granted from Dec. 1, 1917, to Dec. 1, 1918, on Goods in Cold Storage* — Concluded.

ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Shrimp, ...	200	Nov. 19, 1917	Dec. 19, 1918	Union Lobster Company.
Squid,[1]	800	July 21, 1917	Apr. 1, 1919	Atwood & Co.
Squid,[1]	550	Aug. 2, 1917	Apr. 1, 1919	Atwood & Co.
Squid,[1]	1,800	Aug. 10, 1917	Apr. 1, 1919	Atwood & Co.
Squid,[1]	1,175	July 19, 1917	Aug. 30, 1918	Mantia, John.
Squid,[1]	1,800	July 20, 1917	Aug. 30, 1918	Mantia, John.
Squid,[1]	1,600	Oct. 30, 1917	Dec. 1, 1918	Prevoir, Frank.

[1] To be used for bait.

TABLE 4. — *Requests for Extension of Time not granted from Dec. 1, 1917, to Dec. 1, 1918, on Goods in Cold Storage.*

ARTICLE.	Weight (Pounds).	Placed in Storage.	Permission to remove.	Name.
Eggs, canned, . . .	1,320	Aug. 4, 1917	Aug. 4, 1918	Poole, J. R., Company.
Butter, ...	183	July 5, 1917	July 22, 1918	Doe, Sullivan & Co., Inc.
Butter, ...	62	July 12, 1917	July 22, 1918	Doe, Sullivan & Co., Inc.
Butter, ...	6,820	June 27, 1917	June 27, 1918	Ellis, J. R., & Sons.
Butter, ...	900	Aug. 1, 1917	June 13, 1918[1]	Holderness School.
Butter, ...	1,116	July 3, 1917	July 3, 1918	Klink, Carl C.
Butter, ...	2,100	May 24, 1917	May 24, 1918	Samoset Chocolate Company.
Broilers, ...	118	Dec. 2, 1916	Dec. 8, 1917	Borst, Pierce Company.
Broilers, ...	235	Dec. 2, 1916	Dec. 8, 1917	Borst, Pierce Company.
Broilers, ...	88	Dec. 2, 1916	Dec. 11, 1917	Radlo Brothers Company.
Broilers, ...	570	Jan. 2, 1917	Jan. 11, 1918	Radlo Brothers Company.
Broilers, ...	317	Jan. 2, 1917	Jan. 11, 1918	Radlo Brothers Company.
Broilers, ...	619	Jan. 3, 1917	Jan. 11, 1918	Radlo Brothers Company.
Broilers, ...	125	Jan. 6, 1917	Jan. 11, 1918	Radlo Brothers Company.
Broilers, ...	284	Jan. 9, 1917	Jan. 11, 1918	Radlo Brothers Company.
Broilers, ...	2,215	Mar. 26, 1917	Apr. 13, 1918	Skinner, George E., Company.
Broilers, ...	350	Mar. 26, 1917	Apr. 13, 1918	Skinner, George E., Company.
Broilers, ...	944	Mar. 26, 1917	Apr. 13, 1918	Skinner, George E., Company.
Broilers, ...	977	Mar. 26, 1917	Apr. 13, 1918	Skinner, George E., Company.
Broilers, ...	1,629	Mar. 26, 1917	Apr. 13, 1918	Skinner, George E., Company.

[1] Request for extension was made before the year expired, as the school year terminated in June, but the butter was developing rancidity and was ordered out of storage.

TABLE 4. — *Requests for Extension of Time not granted from Dec. 1, 1917, to Dec. 1, 1918, on Goods in Cold Storage* — Concluded.

ARTICLE.	Weight (Pounds).	Placed in Storage.	Permission to remove.	Name.
Chickens,	1,175	Dec. 26, 1916	Dec. 28, 1917	Borst, Pierce Company.
Poultry,	280	Nov. 24, 1916	Dec. 8, 1917	Soracco, T., & Co.
Beef breads,	570	Mar. 28, 1917	Apr. 10, 1918	Dorr, Arthur E., & Co., Inc.
Beef loins,	467	Apr. 10, 1917	Apr. 10, 1918	Sturtevant & Haley.
Mutton,	1,032	June 7, 1917	June 28, 1918	Blackstone Supply Company.
Mutton,	3,393	June 6, 1917	June 28, 1918	Blackstone Supply Company.
Mutton,	391	June 8, 1917	June 28, 1918	Blackstone Supply Company.
Sweetbreads,	72	Apr. 13, 1917	Apr. 13, 1918	Kittredge, R. H.
Veal sweetbreads,	170	Apr. 13, 1917	Apr. 10, 1918	Barker, H. H.
Jowls,	3,750	Mar. 26, 1917	Apr. 10, 1918	Re, Abraham.
Skate fins,	1,202	May 29, 1917	June 13, 1918	Boston Fish Pier Company.
Sole,	8,000	June 12, 1917	June 25, 1918	Burns, John, Company.

TABLE 5. — *Requests granted from Dec. 1, 1917, to Dec. 1, 1918, for Permission to remove Articles which had been in Cold Storage longer than Twelve Months.*

ARTICLE.	Weight (Pounds).	Placed in Storage.	Permission to remove.	Name.
Eggs, canned,	–	Oct. 23, 1916	Jan. 21, 1918	Quincy Market Cold Storage and Warehouse Company.
Eggs, canned,	–	Aug. 28, 1916	Jan. 21, 1918	Quincy Market Cold Storage and Warehouse Company.
Eggs, canned,	–	Oct. 2, 1916	Jan. 21, 1918	Quincy Market Cold Storage and Warehouse Company.
Butter,	60	July 5, 1917	July 23, 1918	Fales, George A.
Butter,	300	July 5, 1917	July 23, 1918	Fales, George A.
Butter,	186	July 19, 1917	Aug. 12, 1918	Green & Co.
Butter,	30	June 13, 1917	Aug. 1, 1918	Smith Brothers.
Butter,	80	June 5, 1917	Aug. 1, 1918	Smith Brothers.
Butter,	20	Aug. 9, 1917	Nov. 21, 1918	Stone, C. H.
Butterine,	600	June 20, 1917	Aug. 1, 1918	Smith Brothers.
Broilers,	213	Dec. 1, 1916	Apr. 15, 1918	Boston Terminal Refrigerating Company.
Capons,	64	Jan. 22, 1917	Feb. 25, 1918	Dorr, Arthur E., & Co., Inc.
Chickens,	320	Dec. 1, 1916	Dec. 21, 1917	Benks, A. P., Company.
Chickens,	172	Dec. 5, 1916	Apr. 15, 1918	Boston Terminal Refrigerating Company.
Chickens,	62	Dec. 19, 1916	Apr. 15, 1918	Boston Terminal Refrigerating Company.
Chickens,	65	Dec. 11, 1916	Apr. 15, 1918	Boston Terminal Refrigerating Company.
Chickens,	175	Jan. 25, 1917	Feb. 22, 1918	Kirsch, F. H.

TABLE 5. — *Requests granted from Dec. 1, 1917, to Dec. 1, 1918, for Permission to remove Articles which had been in Cold Storage longer than Twelve Months* — Concluded.

ARTICLE.	Weight (Pounds).	Placed in Storage.	Permission to remove.	Name.
Chickens,	140	May 9, 1917	Feb. 6, 1918	Strong, Marson Company.
Fowl,	25	Dec. 1, 1916	Apr. 15, 1918	Boston Terminal Refrigerating Company.
Fowl,	250	Dec. 1, 1916	Apr. 15, 1918	Boston Terminal Refrigerating Company.
Fowl,	601	Dec. 4, 1916	Apr. 15, 1918	Boston Terminal Refrigerating Company.
Fowl,	724	Jan. 25, 1917	Feb. 28, 1918	Hutchinson, W. K., Company.
Poultry,	50	Nov. 22, 1916	Dec. 14, 1917	Borst, Pierce Company.
Poultry,	87	–	Apr. 15, 1918	Boston Terminal Refrigerating Company.
Poultry,	804	Dec. 15, 1916	Apr. 15, 1918	Boston Terminal Refrigerating Company.
Poultry,	65	Aug. 29, 1917	Nov. 21, 1918	Eastern Cold Storage Company.
Poultry,	185	Dec. 5, 1916	Dec. 8, 1917	McCabe, M. J., Company.
Turkeys,	216	Dec. 8, 1916	Apr. 15, 1918	Boston Terminal Refrigerating Company.
Turkeys,	232	Dec. 22, 1916	Apr. 15, 1918	Boston Terminal Refrigerating Company.
Venison,	20	Nov. 25, 1915	Feb. 15, 1918	Boyden, George W.
Venison,	7[1]	–	Mar. 30, 1918	Killelea, P. H.
Venison,	7[1]	–	Mar. 30, 1918	Killelea, P. H.
Beef butts,	52	Dec. 12, 1916	Apr. 15, 1918	Boston Terminal Refrigerating Company.
Beef butts,	200	Aug. 4, 1917	Oct. 29, 1918	Boston Terminal Refrigerating Company.
Beef legs,	150	Oct. 5, 1917	Oct. 29, 1918	Boston Terminal Refrigerating Company.
Beef loins,	417	June 8, 1917	Dec. 2, 1918	Union Supply Company.
Beef ribs,	790	May 22, 1917	June 13, 1918	Batchelder & Snyder Company.
Beef rolls,	1,700	Aug. 4, 1917	Oct. 29, 1918	Boston Terminal Refrigerating Company.
Ox tails,	500	May 21, 1917	Aug. 2, 1918	Goodenough & Russell.
Pork,	35	Sept. 6, 1917	Sept. 28, 1918	Harvard Provision Company.

[1] Pieces.

TABLE 6. — *Articles which had been in Cold Storage longer than Twelve Months, and on which no Requests for Extension had been made from Dec. 1, 1917, to Dec. 1, 1918, ordered removed.*

ARTICLE.	Weight (Pounds).	Placed in Storage.	Directed to remove.	Name.
Eggs,	300	Aug. 9, 1917	Aug. 22, 1918	Goldsmith-Wall-Stockwell Company.
Egg yolks,	1,980	July 27, 1917	Sept. 6, 1918	Poole, J. R., Company.
Butter,	1,115	June 14, 1917	July 19, 1918	Crosby Brothers Company.

TABLE 6. — *Articles which had been in Cold Storage longer than Twelve Months, and on which no Requests for Extension had been made from Dec. 1, 1917, to Dec. 1, 1918, ordered removed* — Continued.

ARTICLE.	Weight (Pounds).	Placed in Storage.	Directed to remove.	Name.
Butter,	100	July 30, 1917	Aug. 9, 1918	Curtis & Roberts.
Butter,	60	Oct. 18, 1916	July 29, 1918	Eastern Cold Storage Company.
Butter,	150	Aug. 31, 1917	Sept. 21, 1918	Fairmont Creamery Company.
Butter,	1,500	Aug. 17, 1917	Sept. 30, 1918	Green & Co.
Butter,	40	July 12, 1917	July 29, 1918	Musgrave, G. H.
Butter,	45	July 13, 1917	July 29, 1918	Plymouth Creamery Company.
Butter,	20	Aug. 28, 1917	Sept. 21, 1918	Stone, C. H., & Co.
Butter,	30	Aug. 3, 1917	Aug. 15, 1918	Tibbetts, Nellie M.
Butter,	30	June 9, 1917	July 29, 1918	Wilfert, George.
Broilers,	925	Dec. 9, 1916	Jan. 11, 1918	Armour & Co.
Broilers,	248	Dec. 23, 1916	Jan. 10, 1918	Armour & Co.
Broilers,	1,430	Mar. 2, 1918	Mar. 29, 1918	Childs, Sleeper & Co.[1]
Broilers,	43	June 8, 1917	Aug. 9, 1918	Eastern Cold Storage Company.
Broilers,	128	Dec. 1, 1916	Jan. 18, 1918	Kirsch, F. H., & Co.
Broilers,	88	Dec. 2, 1916	Dec. 11, 1917	Radlo Brothers Company.
Broilers,	120	Aug. 11, 1917	Nov. 18, 1918	Wilcox, C. A.
Chickens,	224	Dec. 9, 1916	Jan. 11, 1918	Armour & Co.
Chickens,	3,012	Dec. 26, 1916	Jan. 18, 1918	Armour & Co.
Chickens,	110	Dec. 26, 1916	Jan. 18, 1918	Armour & Co.
Chickens,	40	Dec. 16, 1916	Jan. 25, 1918	Borst, Pierce Company.
Chickens,	504	Dec. 30, 1916	Jan. 18, 1918	Dorr, Arthur E., & Co., Inc.
Chickens,	320	Dec. 16, 1916	Feb. 20, 1918	English Tea Room.
Chickens,	156	Dec. 4, 1916	Feb. 12, 1918	Harvard Club of Boston.
Chickens,	294	Jan. 11, 1917	Feb. 12, 1918	Harvard Club of Boston.
Chickens,	861	Jan. 25, 1917	Feb. 12, 1918	Harvard Club of Boston.
Chickens,	175	Dec. 22, 1916	Feb. 12, 1918	Harvard Club of Boston.
Chickens,	50	Oct. 1, 1917	Nov. 18, 1918	Strong, Marson Company.
Chickens (Guinea),	55	July 18, 1917	Oct. 24, 1918	Eastern Cold Storage Company.
Chickens (Guinea),	39	Aug. 15, 1917	Sept. 12, 1918	Rodman, B. W.
Chickens,	180	Apr. 30, 1917	Aug. 9, 1918	Eastern Cold Storage Company.
Ducks,	257	Jan. 3, 1917	Jan. 25, 1918	Gunsenheiser, A., & Co.
Fowl,	70	Nov. 22, 1916	Jan. 29, 1918	Batchelder & Snyder Company.
Fowl,	38	May 18, 1917	June 13, 1918	Harvard Provision Company.
Fowl,	92	Nov. 16, 1916	Dec. 2, 1918	Spaulding, F. W.

[1] This lot had previously been stored in another warehouse.

TABLE 6. — *Articles which had been in Cold Storage longer than Twelve Months, and on which no Requests for Extension had been made from Dec. 1, 1917, to Dec. 1, 1918, ordered removed* — Continued.

ARTICLE.	Weight (Pounds).	Placed in Storage.	Directed to remove.	Name.
Poultry,	397	Dec. 7, 1916	Jan. 11, 1918	Armour & Co.
Poultry,	–	Dec. 28, 1917	Jan. 18, 1918	Armour & Co.[1]
Poultry,	–	Dec. 28, 1917	Jan. 18, 1918	Armour & Co.[1]
Poultry,	63	Dec. 29, 1916	Jan. 16, 1918	White, Tucker Company.
Roosters,	35	July 5, 1917	Oct. 24, 1918	Panley, George.
Squab,	–	Sept. 29, 1917	Nov. 15, 1918	Poole, William H.
Turkeys (boxes),	4	Dec. 8, 1916	Dec. 13, 1917	Bowles, J. C.
Turkeys (boxes),	4	Dec. 8, 1916	Dec. 13, 1917	Bowles, J. C.
Turkeys,	600	Dec. 18, 1916	Dec. 26, 1917	Cooper, J. G.
Turkeys,	402	Nov. 28, 1916	Dec. 8, 1917	Cudahy Packing Company.
Turkeys,	3,800	Nov. 28, 1916	Dec. 8, 1917	Dorr, Arthur E., & Co., Inc.
Turkeys (barrels),	36	Jan. 3, 1917	Dec. 17, 1917	Flynn's Market.[1]
Turkeys (barrels),	11	–	Dec. 17, 1917	Morgan, J. G., & Co.[1]
Turkeys,	186	July 3, 1917	Aug. 2, 1918	Strong, Marson Company.
Game,	40	Jan. 30, 1917	Feb. 13, 1918	Robinson, H. C.
Game,	100	Jan. 3, 1917	Jan. 25, 1918	Savage, H. M.
Venison,	53	Nov. 1, 1917	Nov. 18, 1918	Day, C. S., Company.
Venison,	30	–	Jan. 11, 1918	Fyfe, R. M. J.
Beef,	315	Apr. 23, 1917	May 23, 1918	St. Botolph Club.
Beef briskets,	180	Jan. 10, 1917	Jan. 30, 1918	Jacobson, S.
Beef butts,	50	Aug. 4, 1917	Sept. 12, 1918	Dempsey, J. F.
Beef faces,	750	Oct. 10, 1917	Nov. 18, 1918	Chamberlain & Co.
Beef faces,	118	Oct. 3, 1917	Nov. 18, 1918	Thorndike & Stolar.
Beef, Hamburg,	120	July 10, 1917	Aug. 2, 1918	Blackstone Supply Company.
Beef livers,	292	Oct. 5, 1917	Oct. 24, 1918	Clinton Market and Provision Company.
Beef livers,	127	Sept. 18, 1917	Oct. 10, 1918	Curtis & Roberts.
Beef livers,	203	Aug. 31, 1917	Oct. 24, 1918	Kelley, J. J., Company.
Beef livers,	328	Sept. 16, 1917	Sept. 28, 1918	Kelley, J. J., Company.
Beef livers,	1,474	Sept. 18, 1917	Oct. 10, 1918	Pelletier, G. J.
Beef livers,	290	Sept. 18, 1917	Oct. 10, 1918	Prince, C. M., & Son.
Beef loins (bundles),	14	Apr. 13, 1917	Aug. 1, 1918	Keyes Supply Company.
Beef loins,	891	Apr. 13, 1917	Aug. 1, 1918	Keyes Supply Company.
Beef loins,	240	July 12, 1917	Oct. 24, 1918	Lexington Trust Company.
Beef loins,	460	Aug. 15, 1917	Sept. 12, 1918	Union Supply Company.

[1] Had previously been stored in another warehouse.

TABLE 6. — *Articles which had been in Cold Storage longer than Twelve Months, and on which no Requests for Extension had been made from Dec. 1, 1917, to Dec. 1, 1918, ordered removed* — Continued.

ARTICLE.	Weight (Pounds).	Placed in Storage.	Directed to remove.	Name.
Beef rolls,	780	Aug. 7, 1917	Sept. 12, 1918	Wattendorf, G. V.
Beef tenderloins,	394	Aug. 13, 1917	Aug. 26, 1918	Thorndike & Stolar.
Beef tenderloins,	213	Aug. 13, 1917	Aug. 26, 1918	Thorndike & Stolar.
Beef tenderloins,	20	Sept. 7, 1917	Sept. 28, 1918	Thorndike & Stolar.
Beef tenderloins,	200	June 9, 1917	Aug. 1, 1918	Wilkins, D. G., Company.
Lamb,	165	Sept. 5, 1917	Sept. 28, 1918	Blackstone Supply Company.
Lamb,	453	Sept. 5, 1917	Sept. 28, 1918	Blackstone Supply Company.
Lamb,	350	May 29, 1917	July 6, 1918	Dolan, W. J.
Lamb,	60	June 5, 1917	Aug. 2, 1918	Eastern Cold Storage Company.
Lamb,	121	Aug. 7, 1917	Oct. 24, 1918	Eastern Cold Storage Company.
Lamb,	84	June 26, 1917	Sept. 18, 1918	John, Peter.
Lamb,	152	July 6, 1917	Sept. 18, 1918	Rodman, B. W.
Lamb,	150	July 5, 1917	Sept. 18, 1918	Thorndike & Stolar.
Lamb,	810	June 8, 1917	Aug. 1, 1918	Wattendorf, G. V.
Lamb chops,	50	Aug. 6, 1917	Nov. 18, 1918	Brown, C. E.
Lamb chops,	55	Oct. 1, 1917	Nov. 18, 1918	Strong, Marson Company.
Lamb fores,	20	Nov. 6, 1917	Nov. 25, 1918	Johnson, C.
Mutton,	133	Apr. 12, 1917	May 23, 1918	Blackstone Supply Company.
Mutton,	137	July 24, 1917	Aug. 24, 1918	Eastern Cold Storage Company.
Mutton fores,	194	Nov. 23, 1916	Feb. 13, 1918	Bay State Fisheries Company.
Mutton legs,	98	Aug. 22, 1917	Sept. 12, 1918	Union Supply Company.
Ox tails,	40	May 2, 1917	Aug. 1, 1918	Strong, Marson Company.
Ox tails,	56	July 5, 1917	Oct. 24, 1918	Sturtevant & Haley.
Pigs' ears and feet,	116	Oct. 4, 1917	Nov. 18, 1918	Huntley, R. J.
Pigs' feet,	300	Aug. 14, 1917	Nov. 29, 1918	Fay & O'Conner.
Pigs' feet,	3,000	July 18, 1917	Aug. 9, 1918	Dolan, Walter J.
Pork (spare ribs),	3,000	Jan. 25, 1917	Nov. 25, 1918	Blackstone Supply Company.
Pork,	55	Jan. 16, 1917	Feb. 22, 1918	Rodman, B. W.
Pork livers,	500	Aug. 15, 1917	Sept. 7, 1918	Dolan, Walter J.
Pork loins,	700	July 12, 1917	Aug. 2, 1918	Blackstone Supply Company.
Sweetbreads,	12	Apr. 27, 1917	June 5, 1918	Kittredge, R. H.
Sweetbreads,	20	Apr. 14, 1917	May 23, 1918	Thorndike & Stolar.
Sweetbreads,	30	Apr. 14, 1917	May 23, 1918	Thorndike & Stolar.
Sweetbreads,	30	Apr. 14, 1917	May 23, 1918	Thorndike & Stolar.
Sweetbreads,	42	Apr. 14, 1917	May 23, 1918	Thorndike & Stolar.

TABLE 6. — *Articles which had been in Cold Storage longer than Twelve Months, and on which no requests for Extension had been made from Dec. 1, 1917, to Dec. 1, 1918, ordered removed* — Concluded.

ARTICLE.	Weight (Pounds).	Placed in Storage.	Directed to remove.	Name.
Veal,	125	Aug. 8, 1917	Aug. 21, 1918	Armour & Co.
Veal,	4,188	Apr. 11, 1917	May 23, 1918	Blackstone Supply Company.
Veal,	1,615	Apr. 18, 1917	May 23, 1918	Blackstone Supply Company.
Veal livers,	199	Oct. 4, 1917	Oct. 29, 1918	Dorr, Arthur E., & Co., Inc.
Bones,	188	Oct. 21, 1917	Dec. 2, 1918	Spinney, W. J.
Crab claws,	200	Nov. 7, 1916	Jan. 11, 1918	Dewildt, L.
Crab claws,	100	Nov. 29, 1916	Jan. 11, 1918	Dewildt, L.
Halibut,	900	June 2, 1917	June 13, 1918	Atlantic & Pacific Fish Company.
Halibut and salmon,	220	June 2, 1917	June 13, 1918	Atlantic & Pacific Fish Company.
Halibut,	621	Nov. 12, 1917	Nov. 22, 1918	Rush Fish Company.
Herring, small,	700	Nov. 12, 1917	Nov. 22, 1918	Atwood & Co.
Mackerel,	3,146	Oct. 22, 1917	Nov. 22, 1918	Burns, John, Company.
Mackerel,	1,100	Aug. 20, 1917	Sept. 7, 1918	Prevoir, Frank.
Sand eels,	650	Oct. 5, 1917	Oct. 24, 1918	Cefalu, J.
Sardine herring,	315	July 21, 1917	Aug. 14, 1918	Atkins, M.
Sardine herring,	770	Aug. 6, 1917	Aug. 22, 1918	Atkins, M.
Sardine herring,	105	Sept. 4, 1917	Sept. 30, 1918	Atkins, M.
Skatefish,	35	Aug. 3, 1917	Aug. 22, 1918	Cefalu, M.
Skate wings,	70	July 7, 1917	July 29, 1918	Cefalu, M.
Smelts,	105	June 2, 1917	June 13, 1918	Atlantic & Pacific Fish Company.
Squid,	9,200	Sept. 29, 1917	Oct. 24, 1918	Cefalu, M.
Squid,	2,360	Oct. 3, 1917	Oct. 24, 1918	Cefalu, M.
Squid,	14,600	Jan. 5, 1917	Aug. 1, 1918	Globe Fish Company.
Steak pollock,	845	Oct. 3, 1917	Oct. 18, 1918	Bookheim, William, & Sons.
Miscellaneous fish,	200	June 2, 1917	June 13, 1918	Atlantic & Pacific Fish Company.

Inspecting Slaughtering Statistics.

Table 7. — *Nominations for the Office of Inspector of Slaughtering, March 31, 1917, to Dec. 1, 1918.*

Number of nominations made by local boards of health,		482
Number of nominees approved by the State Department of Health,	470	
Number of nominees disapproved by the State Department of Health,	8	
Number of nominees upon which the State Department of Health took no action,	4	
Nominations made late in the year, still pending,		6
Cities and towns making no nominations,		8

Of the total number of nominations made, 48 were new nominees.
Of the nominees approved, 7 resigned and 2 died.
Of the nominees disapproved, 2 were reconsidered and approved.

Copies of licenses to slaughter granted by local boards of health and selectmen sent to this Department, ... 332

Table 8. — *Summary of Report on Inspection of Slaughtering.*

Total number of carcasses inspected,		166,698
Cattle,	29,219	
Calves,	78,156	
Hogs,	56,828	
Sheep,	2,479	
Goats,	16	
Total number of carcasses condemned,		2,240
Cattle,	535	
Calves,	1,411	
Hogs,	285	
Sheep,	9	
Total number of carcasses passed,		164,458

Reason for Condemnation.	Cattle.	Calves.	Hogs.	Sheep.	Totals.
Immaturity,	–	1,192	–	–	1,192
Tuberculosis,	444	12	102	2	560
Actinomycosis,	3	–	–	–	3
Pneumonia,	5	1	17	–	23
Pleurisy,	3	–	–	–	3
Hog cholera,	–	–	101	–	101
Gastritis,	1	–	–	–	1
Indigestion,	–	–	6	–	6
Enteritis,	1	–	2	–	3
Nephritis,	–	–	1	–	1
Inflammation,	2	–	–	–	2

Reason for Condemnation.	Cattle.	Calves.	Hogs.	Sheep.	Totals.
Nodular disease,	–	–	–	4	4
Peritonitis,	8	1	–	–	9
Cirrhosis of liver,	–	–	2	–	2
Necrosis of liver,	1	–	–	–	1
Icterus,	–	8	2	–	10
Diarrhœa,	–	16	–	–	16
Dysentery,	–	11	–	–	11
Abscesses,	3	–	4	–	7
Multiple abscesses,	–	–	1	–	1
Ulcers,	3	–	1	–	4
Abdominal ulcers,	–	–	1	–	1
Hemorrhage,	1	–	–	–	1
Septicæmia,	13	–	5	–	18
Pyæmia,	1	–	–	–	1
Eczema,	–	–	2	–	2
Chloasma,	–	–	3	–	3
Rheumatism,	–	–	1	–	1
Dropsy,	–	–	3	–	3
Fever,	1	–	–	–	1
Mammitis,	2	–	–	–	2
Parturient apoplexy,	–	–	1	–	1
Parturient paresis,	1	–	3	–	4
Difficult parturition,	2	–	–	–	2
Stillbirth,	–	4	–	–	4
Advanced pregnancy,	3	–	–	–	3
Metritis,	2	–	–	–	2
Emaciation,	5	39	10	–	54
Anæmia,	1	–	–	–	1
Cachexia,	–	49	–	–	49
Sexual odor,	–	–	1	–	1
Poisoning,	2	–	–	–	2
Lacerations,	–	8	–	–	8
Bruises,	9	17	1	–	27
Traumata,	5	5	4	2	16
Strangulation,	2	3	–	1	6
Improperly bled,	–	–	1	–	1
Inspector not present,	3	9	–	–	12
Died otherwise than by slaughter,	8	36	10	–	54
Totals,	535	1,411	285	9	2,240

Division of Communicable Diseases.

John S. Hitchcock, M.D., *Director*.

Report of Division of Communicable Diseases.

Changes in Organization.

The District Health Officer, the personal representative of the Commissioner of Health in his District, the convenient and authorized connecting link between the Department and local authorities, must of necessity be a generalist in public health matters. He not only advises local authorities as to general policies and measures but he has a mass of detail to attend to in the forty or more cities and towns in his District. The physical necessity of providing assistance for him was apparent. It was finally decided that a properly qualified Nursing Assistant would be of the most value. She could relieve him of many details and would be of especial value in the many activities among organizations of women who could be more effectively reached by a trained public health nurse than by a man, even though he were a physician. Accordingly a Nursing Assistant to each of the District Health Officers has been appointed.

These nurses had been in office but a very short time when the influenza outbreak appeared and the services they were able to render as organizers and inspectors in that emergency alone more than justified their appointment. Because of this outbreak there is nothing to report on their activities in the lines of work originally planned for them.

While the District Health Officer and the Nursing Assistant must be generalists, the volume of material coming to the office of the Department from the active anti-tuberculosis efforts in this State and from the newly awakened anti-venereal conscience of the military and the civil population made it apparent that office specialization along these lines was a requisite for any measure of success. Accordingly, two subdivisions have been established, — one for tuberculosis and one for the venereal diseases.

The Tuberculosis Subdivision keeps a file of all cases reported in the State, with a rather full report on each case collected from board of health, hospital, dispensary and District Health Officer records. This file is kept as closely up to date as possible and embodies the necessary information regarding the 20,000 or more active cases of tuberculosis, their probable source of infection, and the physical condition and movements of persons in dangerous contact with the case. The Chief

of the Subdivision and the Field Worker in co-operation with the District Health Officers and Nursing Assistants supervise dispensary procedures, records and the follow-up work in rural communities.

The Subdivision of Venereal Diseases is officered by a Chief, a male and a female Epidemiologist and an Educational Organizer. Reports of all cases come here, careless or incorrigible ones are referred back to their local health boards, State Approved Venereal Clinics are supervised, arsphenamine is distributed, and lectures and educational material are provided and distributed. In co-operation with military and civil organizations and with court officials, sources of infection are followed up and their treatment arranged for.

Changes in Personnel and Assignment.

Apr. 1. Dr. John S. Hitchcock appointed director of the Division of Communicable Diseases.

Apr. 1. Dr. Stanley H. Osborn, epidemiologist, entered the military service.

May 13. Dr. Bernard W. Carey of Fitchburg appointed epidemiologist.

June 1. Dr. Merrill E. Champion resigned as District Health Officer to become director of the Division of Hygiene.

June 1. Dr. Lyman A. Jones reappointed District Health Officer and assigned to the Northeastern Health District.

June 1. Dr. Russell B. Sprague of Brighton appointed District Health Officer and assigned to the Eastern Health District.

June 1. Dr. Arthur A. Brown, District Health Officer, transferred to the South Midland Health District.

June 1. Dr. George T. O'Donnell, District Health Officer, transferred to the Connecticut Valley Health District.

June 18. Mary F. Parker appointed assistant bacteriologist in the diagnostic laboratory.

Sept. 1. Dr. Adam S. MacKnight resigned as District Health Officer to become the Superintendent of the Bristol County Tuberculosis Hospital.

Sept. 1. Dr. Charles W. Milliken of Barnstable appointed District Health Officer and assigned to the Southeastern Health District.

Apr. 23. Mary E. Ayer appointed as nursing assistant and assigned to the Connecticut Valley Health District.

May 15. Cecelia A. Lemner appointed as nursing assistant and assigned to the Eastern Health District.

June 1. Mary C. Hoisington appointed as nursing assistant and assigned to the Berkshire Health District.

Sept. 1. Mildred F. Ashley appointed as nursing assistant and assigned to the North Midland Health District.

Sept. 1. Teresa V. Kelley appointed as nursing assistant and assigned to the Southeastern Health District.

Sept. 1. Maria G. Martin appointed as nursing assistant and assigned to the Wachusett Health District.

Sept. 8. Emily M. Rogers appointed as nursing assistant and assigned to the Northeastern Health District.

Sept. 15. Anna Hartnett appointed as nursing assistant and assigned to the South Midland Health District.

Subdivision of Tuberculosis.

Apr. 1. Miss Bernice W. Billings transferred from the Trustees of Hospitals for Consumptives. Appointed chief of subdivision of tuberculosis.

Sept. 14. Miss Medora M. Olmstead resigned as field worker.

Sept. 24. Miss Amy P. Churchill appointed as field worker.

Subdivision of Venereal Diseases.

June 1. Major Alec N. Thomson, M.C., U. S. A., detailed to act temporarily as chief of subdivision of venereal diseases.

June 20. Dr. Mary R. Lakeman appointed as epidemiologist.

Oct. 1. Dr. J. J. Carroll appointed as chief of the subdivision of venereal diseases.

Oct. 1. Dr. Lily O. Burbank appointed as educational organizer.

Epidemiologist (male) not yet appointed.

New Legislation, Acts of 1918, applying to this Division.

General Acts, chapter 58. To provide for the physical examination of inmates of penal institutions. Approved March 11, 1918.

General Acts, chapter 96. Relative to reports and records of venereal diseases. Approved March 26, 1918.

General Acts, chapter 111. Authorizing registered physicians and surgeons to disclose information pertaining to venereal diseases. Approved March 27, 1918.

General Acts, chapter 117. To make uniform physicians' certificates of exemption from vaccination. Approved March 27, 1918.

General Acts, chapter 130. Relative to the reporting of dangerous diseases by local boards of health to the State Department of Health, and its effect on reimbursement of towns for expenses. Approved April 2, 1918.

Special Acts, chapter 140. Appropriating $30,000 for the control, suppression and treatment of venereal diseases. Approved April 24, 1918.

General Acts, chapter 237. Relative to dissemination by advertisement of information concerning certain diseases, amending chapter 386, Acts of 1908. Approved May 28, 1918.

New Rules and Regulations affecting this Division.

Dec. 18, 1917. Gonorrhœa and syphilis, in an infectious stage, were added to the list of the diseases declared to be dangerous to the public health within the meaning of both chapter 670, Acts of 1913, and chapter 213, Acts of 1902.

Apr. 30, 1918. Contract between Hampden and Hampshire counties, providing for the care of tuberculous patients from Hampden County at the Hampshire County Sanatorium, approved.

May Bulletin. Official statement by the Commissioner as to persons and institutions entitled to receive information concerning venereal diseases.

May 21, 1918. Additional venereal disease regulation permitting immediate report by name of venereal cases.

July 8, 1918. Approval of specification of time and manner and form of blank for physical examination of prisoners.

Aug. 9, 1918. Suggested regulations for control of venereal diseases, including definition of "infectious stage," sent to boards of health.

Sept. 30, 1918. Influenza was added to the list of diseases declared dangerous to the public health under the provisions of chapter 670, Acts of 1913, and amendments.

In the year 1918 one great disease outbreak so occupied lay-people, physicians and health officials that ordinary routines went to pieces, and as a consequence the reporting of diseases dangerous to the public health was incomplete and unsatisfactory during the influenza epidemic months. As illustrative, it is hard to believe that typhoid fever, ordinarily at its highest point of incidence in the fall months, and occurring in 184 cases in August and 261 in September, really dropped to 97 cases in October and 48 in November, nor that true lobar pneumonia really did jump from 170 cases in August to 3,114 cases in September, and 3,817 in October, and that there were more cases in September and October than in all the rest of the year combined.

Our figures show, in the eleven most prevalent diseases which were reportable during both years, an increase in four and a decrease in the other seven. In measles, German measles and whooping cough this increase came through their general widespread prevalence during the first six months of the year. Lobar pneumonia was made reportable last year, and its ordinary rate of incidence has not been determined. The more complete reporting of cases in the second year would be expected to give us an increase, but not eight times as much, with over half of that increase bunched in two months. It is clear that much influenza broncho-pneumonia was reported as lobar pneumonia. We are fain to attribute the satisfactory decreases in the other common diseases, in part at least, to efforts at control. We have been trying in every way we could conceive to awaken in the public the sense of the preventability of communicable disease, and to urge them to apply their common sense to the problem. We feel that a 32 per cent decrease in diphtheria, a 30 per cent decrease in mumps, a 24 per cent decrease in scarlet fever, a 6 per cent decrease in pulmonary tuberculosis, and a 31 per cent decrease in typhoid fever, occurring in one and the same year, cannot all be either fortuitous or chargeable to carelessness in reporting during six weeks of a great influenza epidemic, but must be, at least in part, due to efforts at control.

The total volume of cases reported during the year was swelled to unprecedented size by the 145,000 cases of influenza on our records. This disease was not made reportable until the epidemic was about three weeks under way. Hence this figure is no indication of the real prevalence of the disease.

The venereal diseases, gonorrhœa and syphilis, were made reportable early in the year. The number reported does not meet our belief as to the actual prevalence of these diseases. We feel, however, that we have made an excellent start in obtaining some definite knowledge of their prevalence and distribution, and hope for more complete results in the future.

The following table gives the number of reported cases of our most prevalent communicable diseases in their 1918 order of incidence, in comparison with the 1917 figures: —

Disease.	1917.	1918.	Increase.	Decrease.
Influenza,	–	145,262	–	–
Measles,	23,880	29,215	5,335	–
Lobar pneumonia,	1,756	13,374	11,618	–
German measles,	5,890	9,426	3,536	–
Tuberculosis, pulmonary,	8,365	7,833	–	532
Whooping cough,	3,877	7,765	3,888	–
Gonorrhœa,	–	7,681	–	–
Diphtheria,	10,322	6,922	–	3,400
Mumps,	7,125	4,972	–	2,153
Scarlet fever,	5,953	4,490	–	1,463
Chicken pox,	7,210	4,117	–	3,093
Syphilis,	–	3,284	–	–
Ophthalmia neonatorum,	2,325	1,877	–	448
Typhoid fever,	1,546	1,067	–	482

Distribution of Biological Products and Diagnostic Outfits.

The following gives the total number of biological products and diagnostic outfits distributed by the State Department of Health during the year ending Nov. 30, 1918: —

Biological Products.

Diphtheria antitoxin: —

12,000 units (for the Boston City Hospital),	3,502 bottles.
12,000 units,	370 bottles.
6,000 units (for the Boston City Hospital),	192 bottles.
6,000 units,	5,054 bottles.
3,000 units,	33,480 bottles.
2,000 units (for the Boston City Hospital),	310 bottles.
2,000 units,	2 bottles.
1,500 units,	2,759 bottles.
1,000 units,	6,931 bottles.
750 units,	1,315 bottles.

Smallpox vaccine: —	
Capillary tubes,	199,079
Bulk,	12,300 cubic centimeters.
Typhoid vaccine: —	
Ampoules,	10,714
Bulk,	14,975 cubic centimeters.
Typhoid-paratyphoid vaccine: —	
Ampoules,	13,114
Bulk,	12,250 cubic centimeters.
Paratyphoid vaccine: —	
Ampoules,	1,715
Bulk,	50 cubic centimeters.
Antimeningitis serum,	4,867 bottles.
Silver nitrate solution,	48,504 ampoules.

Diagnostic Outfits.

Diphtheria culture tubes,	11,563
Tuberculosis sputum bottles,	5,192
Culture media,	130
Pneumonia outfits,	748
Widal outfits,	2,163
Typhoid culture outfits,	565
Malaria-gonorrhœa outfits,	744

Diagnostic Laboratory.

The total number of examinations made from Dec. 1, 1917, to Dec. 1, 1918, was approximately 18,800.

This is 3,000 less than the average for the last few years. The decrease is due to the small number of school cultures examined for diphtheria, compared with other years. Fewer typhoid cultures were examined also.

There were 396 specimens of feces, urine and blood examined for typhoid bacilli, of which 36 were positive; 8 carriers have been located.

Pneumococcus type determinations have been carried on throughout the year. There have been 997 specimens of sputum examined, many of them in duplicate to compare different methods.

The results were as follows: —

Type I,	92
Type II,	111
Type III,	101
Type IV,	379
Streptococci,	78
No pneumococci (mixed growth),	236

The laboratory staff has taught 20 visitors various branches of the work during the year. The time spent by these pupils has varied from two days to eight weeks, the average being four weeks. A six weeks' course of three hours per day was given to eight college graduates to fit them for war service. The colleges represented were Smith, Simmons and Massachusetts Institute of Technology.

Report of the Subdivision of Tuberculosis of the Division of Communicable Diseases for the Year 1918.

During the period from Dec. 1, 1917, to Nov. 30, 1918, there were 7,930 cases of pulmonary tuberculosis reported and 768 cases of non-pulmonary tuberculosis. There were 5,010 deaths from pulmonary tuberculosis and 724 deaths from non-pulmonary tuberculosis. Of the 8,698 cases of tuberculosis reported up to Nov. 30, 1918, about 1,100 of these were positive and suspected cases of tuberculosis called to the attention of the Department during the year by the local exemption boards and cantonments in the country; 615 of these were positive cases that in all probability would not have come to the attention of the Department through any other source.

Follow-up Work.

An effort is being made to secure follow-up work in all cases of tuberculosis, and to keep on file in the office of the State Department of Health accurate data in regard to each patient. Up to the present time 7,550 histories of tuberculosis patients have been received from nurses engaged in either full or part time tuberculosis nursing.

Supervision of Tuberculosis Dispensaries.

The dispensary supervisor has visited the tuberculosis dispensaries in the Northeastern Health District. A detailed report on each dispensary has been sent out to the Health Officer in the district. This supervision should result in more complete and accurate records in the tuberculosis dispensaries. It should also eliminate the cards representing those who have died, or who have left the State, from the active case files in the office of the State Health Department.

Barnstable County Survey.

A tuberculosis survey of Barnstable County was made in April, 1918. This survey established the fact that there was a sufficient number of tuberculosis patients to fill the county hospital.

Cambridge Survey.

A tuberculosis survey of the city of Cambridge was commenced July 1, 1918. Due to the lack of nursing assistance and to the influenza epidemic this survey will not be completed until January, 1919.

Influenza Epidemic.

During the epidemic the entire force of the subdivision was engaged in enrolling, assigning and reassigning nurses and nursing assistants to afflicted cities and towns in the Commonwealth. Approximately 1,100 nurses and nursing assistants were enrolled. There were 1,330 assignments to 106 cities and towns.[1]

Subdivision of Venereal Diseases.

The organization of the work of this subdivision has presented peculiar problems. Ordinarily a new departure in public health work starts in a small way and develops slowly, but here the immense problems of venereal diseases as such, and their physical, mental, moral, spiritual, economic and sociological results and ramifications, were simultaneously thrust for solution upon public officials by awakened public knowledge and public demand for relief. The Department came early to the conclusion that, in its capacity of an official public health organization, it must confine its activities to disease eradication, and must leave the questions of physical, mental and moral results to other agencies. Just where to draw this line in practice is a difficult question to settle. The prevention of a contagious disease usually involves interference with the movements of persons not actively but potentially diseased, and public opinion, while demanding protection from venereal diseases, is still tender and hesitating in its treatment of the morally guilty in order to protect the sensibilities of morally innocent sufferers. It is therefore difficult to discover and render non-infectious many of the most dangerous sources of infection.

The Department has secured the establishment of and is subsidizing with money and with arsphenamine twelve of the sixteen proposed venereal clinics located in centers throughout the State. Here expert treatment and consultation are available. The four remaining clinics will soon be established, as will also a few subclinics. The attendance at these clinics appears to be increasing.

The manufacture of arsphenamine is increasing in volume. The distribution of doses has been as follows: —

[1] The difference between the number enrolled and the number assigned is due to the fact that some nurses, on the completion of their work in one town, were reassigned to another town.

January to July,	650
July,	84
August,	467
September,	445
October,	535
November,	1,057
	3,238

During the year the venereal diseases have been reported by number, as follows: —

Gonorrhœa: —		
Male,	5,149	
Female,	1,868	
Unknown,	19	
		7,036
Syphilis: —		
Male,	1,767	
Female,	1,219	
Unknown,	26	
		3,012
Total,		10,048

Of these, 1,182 were reported by name as cases which were neglecting treatment and should have official supervision in order to protect others from their disease. These were divided as follows: gonorrhœa, 826; syphilis, 356. These cases are the type of negligent or wilful persons who are the most dangerous disseminators of venereal disease. As they are actually diseased they come within our conception of the limits of our duty. Through our epidemiologist, these cases are reported to their local boards and every assistance given in pursuit of them. The record is as follows: —

Unable to locate (because of false address or leaving the State),		265
Gonorrhœa,	208	
Syphilis,	57	
Still in process of follow-up,		338
Gonorrhœa,	247	
Syphilis,	91	
Returned to treatment,		579
Gonorrhœa,	371	
Syphilis,	208	

That almost 50 per cent of the wilful negligent class have been found and brought back to supervised treatment is remarkable.

Inspection of Hospitals.

During the year 82 hospitals were inspected, 43 of these were general and 39 were special. In no instance was any definitely unsanitary condition or practice found.

Inspection of Lock-ups and Houses of Detention.

A total of 196 reformatories, jails, houses of correction, lock-ups and police stations were inspected. In 12 of the lock-ups and police stations conditions were found that warranted action by the District Health Officer. All of the others were in a satisfactory sanitary condition.

Report of the Epidemiologist for the Year ending Nov. 30, 1918.

Actinomycosis. — Actinomycosis was reported but once during the year. This case occurred in the city of Cambridge, and was due, in all probability, to infected beef.

Anterior Poliomyelitis. — During the year 99 cases, with 38 deaths, were reported to this office. The cases occurred sporadically throughout the State, and in no instance showed any evidence of assuming epidemic proportion.

No change occurred in seasonal, age or sex incidence from that recorded in other years.

Total cases,	99
Total deaths,	38
Case rate per 100,000 population,	2.5
Death rate per 100,000 population,	1.0

Anthrax. — The total number of anthrax cases reported for the year was 23, with 7 deaths. These cases were scattered throughout the State, and all but 3 were infected by hides imported into this country from China on consular certification, and therefore without disinfection.

The procedure formulated by the Department in 1915 has been carefully followed, and, with the co-operation of the State Board of Labor and Industries, the brokers from whom the hides were purchased have been notified that certain lots were infected with anthrax. The brokers in turn notified the manufacturers who received the hides and they disinfected them.

Two cases occurred among wool workers, and one in a boy who worked in a hair-renovating factory. As these 3 cases were not verified by laboratory test there is some doubt as to the correctness of diagnosis.

Chicken Pox. — A marked decrease in reported cases was shown this year, the total number of cases being 4,117, with 8 deaths, as compared with 7,210 cases and 20 deaths for 1917.

Public health interest in chicken pox lies in the fact that since every now and again smallpox showing an atypical course and form of eruption closely simulates chicken pox, there is grave danger of confusing the two diseases. With the reporting of chicken pox we are able to note cases occurring in the later age groups; or, if an undue number of deaths occur, no time is lost in starting an investigation to differentiate the conditions and rule out smallpox.

Dog Bite. — Dog bite was officially reported in 20 instances. Upon investigation it was found that 16 dogs and 1 cow gave positive findings.

Residents of the following cities and towns were bitten: Attleboro, 1; Barre, 3; Boston, 3; Charlton, 1; Clinton, 1; Lawrence, 1; Lowell, 1; Methuen, 1; North Attleborough, 3; Taunton (same dog), 2; Ware, 1; Worcester, 2.

In Plainville one person was either bitten or licked by a cow which had received its infection from a rabid dog.

Lancaster and Quincy each reported a dog bite, but upon investigation by the District Health Officer it was found that no one had been infected.

Dysentery. — During the year 79 cases of dysentery were reported and 75 deaths. Many of these cases were diagnosed solely upon clinical findings, and some on investigation proved not to be true dysentery, but rather an enteric disturbance caused by indiscretions of diet, and save in elderly people not of serious import.

One investigation was made in Randolph, where a young child died and 3 other members of the family had been ill. Autopsy showed no great pathological change save minute ulceration in rectum. Bacteriological examination proved the presence of the Shiga bacillus.

In Milton 4 children and their mother became ill with symptoms of a violent dysenteric attack, 2 of the younger children died and the remaining patients recovered after a somewhat protracted illness. The course of the mother's seizure became almost typical of typhoid. Laboratory examinations were negative for all the patients.

Epidemic Cerebrospinal Meningitis. — Epidemic cerebrospinal meningitis was reported in 378 instances, an increase of 182 cases over 1917, when 196 cases were reported; 229 deaths were reported in 1918 as compared with 158 during 1917.

From the case histories received it is apparent that many of the cases were diagnosed just before the death of the patient and on clinical symptoms alone. A study of these histories showed that at least

50 per cent of the cases presented good grounds for doubting the accuracy of the diagnosis.

Public health interest in epidemic cerebrospinal meningitis lies in the fact that the mortality rate is extremely high, and it possesses all the features of a communicable disease. Its mode of transmission is by contact with either the acutely ill or the healthy carrier. Its diagnosis may be made by bacteriological examination for the acutely ill and the carrier. The findings of the *diplococcus intracellularis meningitidis* in the spinal fluid or in the nasopharynx definitely classifies the condition, and the use of the Flexner serum given intradurally is the only curative agent known.

In view of the fact that the serum is harmless, it is most earnestly recommended that it be administered at the time the spinal puncture is made for diagnosis.

German Measles. — German measles was reported in 9,426 instances, with 8 deaths. Because of the frequency with which German measles is confused with the more serious eruptive fevers, such as scarlet fever, the value of reporting it to boards of health is apparent.

Leprosy. — Three cases of leprosy were reported during the year; 2 cases were placed in the Leprosarium at Penikese Island, and one, who knew that a neighboring State did not quarantine for this condition in the earlier stages of the disease, left the State before he could be apprehended.

Lobar Pneumonia. — During the year 13,374 cases of lobar pneumonia were reported. A large number of these cases were reported during the pandemic of influenza, so that it is fair to assume that many "influenza-pneumonias" are included in this number.

As lobar pneumonia has been reportable since May, 1917, only, there has not been a sufficient sequence of reported cases to establish an index which will be of value.

Malaria. — Our malaria problem is by no means reflected by the number of cases reported. More liberal use of the laboratory will surely show a larger number of cases to be reported. With so many breeding places in the State of large numbers of the proper species of mosquito, and an uncertain number of healthy carriers among both our resident and our floating population, this is only to be expected.

Measles. — The warning goes forth yearly that measles is not a simple disease of childhood, to be contracted because "now is a good time to have it." It has been definitely proven that measles, while not serious in itself, does by some unknown process prepare the patient for the invasion of an added infection whose mortality rate is appalling.

The predominant organism in this complication is the *streptococcus hemolyticus* found in many healthy carriers. When these carriers come

in contact with those slightly ill, or recovering from measles, most disastrous consequences are liable to follow.

Other complications, such as pulmonary tuberculosis and otitis media, are relatively frequent in occurrence and dire in their consequences.

Outbreaks.

During the year 1918 there have been but 39 outbreaks of sufficient size to occasion the sending of "outbreak" notices.

Diphtheria seemed to be approaching epidemic proportion in 12 instances, giving a total of 285 cases investigated. The highest total number of cases in any of these outbreaks was 37. Contact was shown to be the main factor in each outbreak.

Measles. — Thirty-three cities showed undue prevalence for measles; 10,624 cases were reported under epidemic conditions. Boston, Quincy, Beverly, Haverhill, Somerville, Marlborough and Springfield reported over 400 cases each during February, March and April.

Scarlet Fever. — In 9 instances scarlet fever appeared in excessive numbers. One outbreak totaled 124 cases and proved to be transmitted by milk. The total number of cases for these outbreaks was 280.

Typhoid Fever. — Only in one instance did typhoid fever reach the proportion of an epidemic. One city, with 33 cases, due to milk infection, showed alarming incidence.

Influenza in Massachusetts.

Influenza, with its 145,262 reported cases and 11,100 deaths, is the outstanding feature of our work for the year 1918.

The explosive nature of the pandemic, our ignorance as to etiology, mode of transmission and excessive death rate, together with the anxiety of the citizens of the State, made the problem extremely difficult to handle.

Early in the beginning of the outbreak it seemed that our only hope to prevent the spread of the infection was to prevent contact infection, and this we tried to do. Our results were negative; we did not, and, in fact, could not, stem the tide of this overwhelming invasion when the foci of infection were scattered over the State with no means available to detect their presence unless, perchance, they were acutely ill.

Much time, money and energy were spent developing a vaccine which might have prophylactic value, and which would lessen the incidence of the infection. No statistics have been produced which prove that this vaccine had any value.

The one phase of our work which furnished satisfaction to us was that we were able to furnish a sufficient number of physicians and

nurses to help in the care of those afflicted. During this period 238 physicians and 1,097 nurses were sent out from this office to the stricken communities.

Epidemiology. — The pandemic of influenza appeared in Massachusetts during the latter part of August, the first known cases being diagnosed at the Naval Hospital in Chelsea, as noted in the United States Public Health Service Report.

As influenza was not made reportable by the State Department of Health until October 4, its onset must be estimated by the death returns, or from the reports furnished voluntarily by the physicians. From these data the onset and progress of the disease in this State was in part as follows: —

	Onset.	
	By Deaths.	By Reports.
Chelsea (Naval Hospital),	-	Aug. 10
Haverhill,	Sept. 12	Sept. 8
Boston,	Sept. 7	Sept. 13
Medford,	Sept. 10	Sept. 13
Winthrop,	Sept. 11	Sept. 13
Chelsea (civilian),	Aug. 28	Sept. 16
New Bedford,	Sept. 8	Sept. 19
Pittsfield,	Sept. 13	Sept. 19
Lowell,	Sept. 14	Sept. 20
Arlington,	Sept. 10	Sept. 21
Springfield,	Sept. 23	Sept. 23
Greenfield,	Sept. 22	Sept. 26
North Adams,	Sept. 23	Sept. 30

Thus it appears that the first cases in the State were discovered in the eastern section, and, following the usual lines of travel, reached the western cities and towns in approximately two weeks.

An interesting feature in the onset of influenza in this State was the sudden increase in number of reported cases of lobar pneumonia from Camp Devens. During the month of August, up to the 26th, there were reported but 12 cases, while from the 26th to September 1, 98 cases were reported, making a total for the month of 110 cases. This sudden increase of lobar pneumonia may possibly have been due to an unrecognized infection of influenzal origin.

Etiology. — The etiology of influenza is as yet undetermined. While a majority of observers have agreed that the pneumococci, the streptococci, both hemolytic and viridans strains, *micrococcus catarrhalis* and influenza bacillus are present in the complications, none are agreed on the initial invading organism. Some feel that a diplostreptococcus is the offending agent, while others lean toward the theory of a filterable virus; and so it goes on, with no definite proof of the actual agent yet available.

It is of interest to note that all experimental efforts to infect volunteers have failed thus far.

The incidence of the infection varied widely and for no apparent reason. For instance, Marlborough, surrounded by cities and towns almost overwhelmed by the outbreak, had few cases and needed no help. The case rate must remain unknown. The disease was not reportable at the time of the beginning of the outbreak, and the volume of cases made estimates particularly unreliable. Through information from all available sources the number in Boston alone is put at 200,000, and for the whole State at 500,000.

At Camp Devens from October 2 to October 29 there were 231 cases of influenza-pneumonia, and of this number 127 died, a fatality of 54.9 per cent. Of the 2,817 cases at this camp, reported from September 4 to October 29, 787 died, or 27.9 per cent. The Naval Hospital in Chelsea had about the same percentages, save in 150 cases treated with the serum from convalescent influenza-pneumonia cases, where the fatality was only 4 per cent.

The mortality rate for the State varied widely. Gloucester, with a rate of 9 per 100,000 population, was apparently the most severely afflicted city in the State. The general rate for the State was given by the United States Public Health Service as 5.4.

One striking feature was the marked decrease in the fatality rate as the pandemic progressed. Early in the outbreak the reported mortality of influenza-pneumonia from hospitals was nearly 60 per cent.

Modes of Transmission. — As the etiology of influenza is not yet determined, the mode or modes of transmission cannot be positively stated; but since the disease attacks principally the respiratory tract, it seems very probable that the infective micro-organism or virus is contained in the secretions and discharges of this tract, and that the infection is spread mainly through these discharges. If this be so, then droplet infection must be considered as one of the principal modes of transmission of the disease. Likewise contact, both direct and indirect, will prove to be another important means of spread.

Prevention and Control. — The methods of prevention and control of

influenza, and the efficiency of the measures generally adopted during the epidemic; the general closing orders; the use of masks; the care of hands; the care of food and utensils; the use of prophylactic vaccines; and the isolation and quarantine of patients have been widely discussed.

From the lack of knowledge of the etiology, the lack of knowledge of prophylactic vaccines, the lack of knowledge of the exact modes of transmission, no definite measures of control could be formulated that would be applicable to all communities, but it did seem to be the general opinion that the following measures were best adapted to aid in the control of influenza: —

1. Compulsory reporting of cases of patients ill with influenza.
2. Isolation of patient and quarantine if necessary.
3. Disinfection of discharges from the nose and throat.
4. Wearing of masks by attendants in sick room.
5. Care of the hands of patients.
6. Care of food utensils.
7. General closing orders, especially those places where crowding was most liable to occur.
8. Education and publicity.

Cases and Deaths, with Case and Death Rates, per 100,000 Population for All Reportable Diseases during the Year 1918.

Disease.	Cases.	Deaths.	Case Rate.	Death Rate.
Actinomycosis,	1	–	.03	–
Anterior poliomyelitis,	99	38	2.5	1.0
Anthrax,	23	7	.6	.2
Chicken pox,	4,117	8	105.0	.2
Diphtheria,	6,922	604	176.5	15.4
Dog bite,	20	–	.5	–
Dysentery,	79	75	2.0	1.9
Epidemic cerebrospinal meningitis,	378	229	9.6	5.8
German measles,	9,426	8	240.4	.2
Gonorrhœa,[1]	7,681	8	195.9	.2
Influenza,[2]	145,262	11,100	3,704.7	283.1
Leprosy,	3	–	.1	–
Malaria,	82	4	2.1	.1
Measles,	29,215	533	745.1	13.5
Mumps,	4,972	9	126.8	.2
Ophthalmia,	1,877	1	47.9	.03
Pellagra,	19	22	.5	.6

[1] Made reportable Feb. 1, 1918. [2] Made reportable Oct. 4, 1918.

Cases and Deaths, with Case and Death Rates, per 100,000 Population for All Reportable Diseases during the Year 1918 — Concluded.

Disease.	Cases.	Deaths.	Case Rate.	Death Rate.
Pneumonia, lobar,	13,374	9,787	341.1	249.6
Scarlet fever,	4,490	77	114.5	2.0
Septic sore throat,	107	25	2.7	.6
Syphilis,[1]	3,284	261	83.8	6.7
Smallpox,	27	–	.7	–
Tetanus,	27	32	.7	.8
Trachoma,	103	–	2.6	–
Trichinosis,	15	–	.4	–
Tuberculosis, pulmonary,	7,833	5,106	200.0	130.2
Tuberculosis, other forms,	747	786	19.1	20.0
Typhoid fever,	1,067	160	27.2	4.1
Typhus fever,	2	1	.05	.03
Whooping cough,	7,765	719	198.0	18.3

[1] Made reportable Feb. 1, 1918.

Incidence of Communicable Diseases by Months, 1918.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Actinomycosis,	1	–	–	–	–	–	–	–	–	–	–	–	1
Anterior poliomyelitis,	5	3	6	6	6	6	10	20	20	7	7	3	99
Anthrax,	1	5	2	1	–	3	4	1	3	–	3	–	23
Chicken pox,	872	490	422	434	609	356	312	88	63	74	141	256	4,117
Diphtheria,	950	678	744	667	663	473	453	337	430	410	532	585	6,922
Dog bite,	2	–	–	1	6	2	1	2	2	2	4	1	23
Dysentery,	–	2	2	–	–	4	30	20	11	3	6	1	79
Epidemic cerebrospinal meningitis,	21	35	51	67	36	36	25	18	18	31	19	21	378
German measles,	705	1,415	2,149	2,411	2,070	490	97	32	14	15	8	20	9,426
Ophthalmia neonatorum,	134	133	133	155	114	113	131	120	92	80	71	90	1,366
Suppurative conjunctivitis,	39	46	69	106	62	30	33	23	25	21	31	26	511
Leprosy,	–	–	–	–	–	2	–	–	–	1	–	–	3
Malaria,	–	1	2	5	4	5	16	31	9	4	2	3	82
Measles,	2,950	3,471	4,018	5,210	6,335	3,663	1,962	500	263	318	179	346	29,215
Mumps,	711	678	722	794	743	472	190	71	80	174	203	134	4,972
Pellagra,	–	–	2	2	2	6	1	2	1	2	1	–	19
Pneumonia (lobar),	698	876	800	1,184	573	204	139	171	3,114	3,797	615	1,203	13,374
Scarlet fever,	609	537	540	626	487	287	200	122	177	225	287	393	4,490
Septic sore throat,	16	12	13	19	10	12	3	2	2	4	4	10	107
Smallpox,	3	2	10	2	3	1	1	–	2	–	3	–	27
Tetanus,	1	–	2	–	3	3	4	2	4	4	2	2	27
Trachoma,	9	7	8	10	9	11	8	17	6	4	5	9	103
Trichinosis,	9	5	–	–	–	–	1	–	–	–	–	–	15
Tuberculosis, pulmonary,	637	676	815	779	884	764	613	604	570	439	525	527	7,833
Tuberculosis, other forms,	69	76	84	86	80	54	82	58	48	24	45	41	747
Typhoid fever,	54	38	41	52	71	64	112	184	261	97	49	44	1,067
Typhus fever,	–	1	–	–	1	–	–	–	–	–	–	–	2
Whooping cough,	865	679	759	855	1,001	829	781	688	543	332	216	217	7,765
Gonorrhœa,[1]	–	47	982	835.	787	815	750	828	669	552	771	645	7,681
Syphilis,[1]	–	16	376	415	334	329	285	360	298	233	365	273	3,284
Influenza,[2]	–	–	–	–	–	–	–	–	–	88,494	14,750	42,018	145,262
	9,361	9,929	12,752	14,722	14,893	9,034	6,244	4,301	6,725	95,347	18,844	46,868	249,020

[1] Not reportable until February, 1918.

[2] Made reportable Oct. 4, 1918.

Index to Line Numbers in the Table of Cases and Deaths from Diseases Dangerous to the Public Health, 1918.

Index to Line Numbers in the Table of Cases and Deaths from Diseases Dangerous to the Public Health, 1918 — Continued.

Index to Line Numbers in the Table of Cases and Deaths from Diseases Dangerous to the Public Health, 1918 — Concluded.

Cases and Deaths from Diseases Dangerous

Line No.	Cities and Towns grouped in Order of Population.	Population estimated as of July 1, 1918.	19A Chicken Pox.		61A Ep. Cerebrospinal Meningitis.		9 Diphtheria.		19B German Measles.		92 Lobar Pneumonia.		6 Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
1	Massachusetts,	3,920,988	4117	8	378	229	6922	604	9426	8	13374	9787	29215	533
2	Cities over 500,000.													
3	Boston,	793,471	750	–	111	77	2443	223	722	–	2256	1891	6281	107
4	Cities over 150,000.													
5	Worcester,	173,419	73	1	28	16	215	21	240	–	957	624	315	8
6	Cities, 100,000-150,000.	*578,593*	*588*	*1*	*59*	*31*	*1101*	*108*	*530*	*1*	*1945*	*1475*	*3473*	*94*
7	Fall River,	128,317	87	–	12	7	166	27	50	–	398	263	218	9
8	New Bedford,	117,855	84	1	4	6	110	20	11	–	240	271	361	26
9	Springfield,	111,983	169	–	6	6	231	31	179	–	853	393	988	13
10	Cambridge,	111,379	213	–	19	3	401	12	219	1	327	291	1412	28
11	Lowell,	109,059	35	–	18	9	193	18	71	–	127	257	494	18
12	Cities, 50,000-100,000.	*569,719*	*375*	*3*	*49*	*36*	*940*	*90*	*1146*	*1*	*1913*	*1302*	*4872*	*115*
13	Lynn,	99,952	28	–	6	2	148	8	390	1	261	172	307	6
14	Lawrence,	93,060	33	–	10	9	107	18	22	–	194	199	1487	76
15	Somerville,	93,026	31	1	5	3	254	23	124	–	216	138	852	10
16	Brockton,	65,746	77	–	2	1	48	2	379	–	179	131	232	1
17	Holyoke,	62,796	37	1	1	2	47	6	6	–	131	198	189	2
18	Haverhill,	52,873	88	1	3	3	88	9	141	–	641	200	717	7
19	Malden,	51,798	31	–	9	5	166	20	59	–	69	119	584	1
20	Chelsea,	50,468	50	–	13	11	82	4	25	–	222	145	504	12
21	Cities and Towns, 25,000-50,000.	*487,764*	*698*	–	*41*	*19*	*759*	*57*	*1970*	*1*	*1104*	*1069*	*4695*	*63*
22	Quincy,	45,827	90	–	3	–	84	6	181	–	64	96	794	11
23	Newton,	45,234	196	–	3	1	104	12	505	–	89	67	393	4
24	Pittsfield,	44,410	39	–	10	5	28	2	145	–	142	135	94	1
25	Salem,	41,082	33	–	7	3	47	3	197	–	182	105	537	9
26	Fitchburg,	40,830	28	–	3	3	67	6	172	–	231	147	464	15
27	Everett,	40,435	18	–	–	1	112	2	13	–	82	102	217	–
28	Taunton,	37,381	12	–	1	1	20	1	1	–	28	114	86	1
29	Brookline,	37,147	127	–	1	–	42	2	392	–	132	64	506	–
30	Medford,	35,230	36	–	4	–	69	6	70	–	10	54	258	–
31	Chicopee,	33,177	23	–	2	2	56	11	2	–	28	39	89	1
32	Waltham,	31,643	87	–	2	3	38	2	194	1	27	62	676	6
33	Revere,	29,643	–	–	4	–	77	4	–	–	30	48	–	8
34	Beverly,	25,725	9	–	1	–	15	–	98	–	59	27	581	7
35	Cities and Towns, 10,000-25,000.	*575,996*	*812*	*1*	*33*	*25*	*774*	*53*	*2056*	*3*	*1410*	*1315*	*4111*	*67*
36	Gloucester,	24,529	16	–	1	1	14	1	36	–	23	92	45	5
37	Northampton,	23,081	40	–	–	–	20	5	82	–	44	26	100	–
38	North Adams,	22,045	19	–	1	1	11	3	7	–	38	35	6	–
39	Peabody,	20,489	18	–	–	2	30	5	25	–	34	35	238	3
40	Attleboro,	19,933	17	1	–	–	13	1	133	–	68	58	54	1
41	Westfield,	19,929	68	–	2	–	31	7	119	–	158	63	26	1
42	Watertown,	18,851	9	–	2	–	35	1	21	1	59	51	152	3
43	Framingham,	17,728	39	–	–	1	12	–	344	–	28	28	61	1

to the Public Health, 1918.

19C Mumps.		38A[1] Ophthalmia Neonatorum.		7 Scarlet Fever.		28–29 Tuberculosis, Pulmonary.		30–35 Tuberculosis, Other Forms.		1 Typhoid Fever.		8 Whooping Cough.		100 Septic Sore Throat.		75A Trachoma.		38C Gonorrhœa.		37 Syphilis.		Line No.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
4972	9	1877	1	4490	77	7833	5106	747	786	1067	160	7765	719	107	25	103	–	7681	8	3284	261	1
																						2
783	1	623	–	974	26	2649	1161	252	191	99	22	2002	179	21	3	61	–	3399	–	1494	60	3
																						4
16	1	149	1	179	2	318	203	24	47	23	6	55	6	–	1	4	–	359	–	178	23	5
654	*1*	*410*	–	*472*	*10*	*1387*	*954*	*152*	*162*	*283*	*39*	*1399*	*153*	*16*	*3*	*13*	–	*976*	–	*317*	*24*	6
114	–	116	–	114	–	354	226	32	24	158	18	310	33	11	1	1	–	205	–	65	7	7
24	–	123	–	57	3	414	221	48	46	50	11	141	29	–	–	1	–	188	–	35	5	8
398	–	72	–	141	3	185	127	31	28	32	4	302	37	1	1	2	–	279	–	88	5	9
114	1	50	–	63	–	212	223	27	24	23	4	588	32	2	–	6	–	177	–	75	1	10
4	–	49	–	97	4	222	157	14	40	20	2	58	22	2	1	3	–	127	–	54	6	11
328	*2*	*363*	–	*631*	*10*	*981*	*568*	*113*	*87*	*147*	*26*	*1085*	*107*	*9*	*3*	*11*	–	*654*	–	*229*	*25*	12
45	–	73	–	109	2	158	107	17	17	22	2	199	23	1	1	–	–	127	–	53	9	13
11	–	12	–	16	–	208	143	41	29	36	10	189	23	–	–	2	–	62	–	53	4	14
27	–	29	–	102	–	145	74	8	7	14	2	122	16	1	1	2	–	68	–	31	1	15
154	–	96	–	158	1	101	53	11	6	22	6	273	6	–	–	–	–	92	–	32	2	16
16	–	9	–	61	1	77	68	3	8	8	1	42	17	–	–	–	–	57	–	4	3	17
54	1	49	–	57	2	120	39	14	5	17	3	63	6	6	1	1	–	142	–	31	2	18
6	1	27	–	68	3	68	37	11	10	14	1	93	7	–	–	–	–	35	–	12	2	19
15	–	68	–	60	1	104	47	8	5	14	1	104	9	1	–	6	–	71	–	13	2	20
409	*2*	*98*	–	*608*	*8*	*871*	*502*	*73*	*83*	*119*	*22*	*1023*	*78*	*18*	*4*	*2*	–	*470*	*1*	*136*	*39*	21
19	–	6	–	61	–	72	34	5	9	6	2	75	6	–	–	–	–	44	–	10	2	22
89	1	10	–	29	1	55	28	9	13	9	2	312	3	4	3	–	–	25	–	10	3	23
24	–	13	–	104	2	109	53	10	9	5	–	36	2	–	–	–	–	49	–	17	1	24
42	–	11	–	58	1	58	50	9	6	7	3	9	2	3	1	–	–	50	1	10	2	25
52	1	6	–	37	1	105	45	14	5	6	1	73	10	–	–	1	–	56	–	10	3	26
15	–	18	–	52	–	85	34	6	4	11	1	88	4	1	–	–	–	30	–	6	–	27
27	–	3	–	46	2	134	94	5	6	11	–	84	15	–	–	–	–	28	–	17	24	28
49	–	–	–	66	–	44	33	4	–	4	–	178	2	4	–	–	–	8	–	5	–	29
3	–	5	–	62	–	37	27	2	5	5	–	33	10	2	–	1	–	22	–	6	–	30
24	–	7	–	7	–	71	51	1	11	3	–	13	2	1	–	–	–	12	–	3	–	31
60	–	10	–	24	1	36	32	7	13	2	2	101	13	1	–	–	–	46	–	10	2	32
–	–	3	–	44	–	39	11	–	–	12	4	–	5	–	–	–	–	82	–	27	1	33
5	–	6	–	18	–	26	10	1	2	38	7	21	4	2	–	–	–	18	–	5	1	34
1017	–	*118*	–	*651*	*5*	*815*	*572*	*68*	*96*	*187*	*22*	*999*	*97*	*16*	*8*	*10*	–	*385*	*7*	*167*	*37*	35
2	–	2	–	47	–	50	19	8	4	18	1	9	1	1	1	4	–	21	–	9	2	36
34	–	4	–	32	1	39	68	3	6	3	3	23	2	–	–	1	–	9	4	17	23	37
9	–	2	–	3	–	31	23	3	3	6	2	22	1	–	–	–	–	5	1	1	–	38
17	–	5	–	16	–	37	13	6	4	5	–	3	4	–	–	1	–	25	–	3	–	39
5	–	3	–	8	–	17	10	5	6	3	1	59	8	1	–	–	–	15	–	15	1	40
93	–	4	–	69	1	29	62	3	–	11	–	43	2	–	–	–	–	7	–	3	–	41
4	–	3	–	25	–	29	12	1	2	3	–	54	1	3	1	1	–	12	–	9	–	42
11	–	3	–	12	–	38	9	1	–	4	–	67	2	1	–	–	–	17	–	4	–	43

[1] Including 511 cases of suppurative conjuctivitis.

Cases and Deaths from Diseases Dangerous

Line No.	Cities and Towns grouped in Order of Population.	Population estimated as of July 1, 1918.	19A Chicken Pox.		61A Ep. Cerebrospinal Meningitis.		9 Diphtheria.		19B German Measles.		92 Lobar Pneumonia.		6 Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
44	Leominster,	17,688	24	–	2	–	28	3	87	–	97	57	194	–
45	Melrose,	17,627	46	–	–	–	24	2	108	–	76	54	50	–
46	Gardner,	17,451	14	–	–	–	100	1	114	–	55	70	51	1
47	Arlington,	17,264	21	–	1	–	33	1	49	–	17	41	140	–
48	Woburn,	17,116	7	–	–	1	16	–	29	–	16	16	101	2
49	Marlborough,	15,680	15	–	2	2	15	1	50	–	19	27	784	4
50	Methuen,	15,649	12	–	–	2	5	–	9	–	9	21	195	7
51	Newburyport,	15,542	92	–	3	2	5	1	23	–	31	44	63	–
52	Southbridge,	15,255	4	–	–	–	11	1	–	–	7	56	67	4
53	Weymouth,	14,659	–	–	1	–	23	1	–	–	18	41	–	1
54	Winthrop,	14,443	1	–	3	1	31	–	73	–	121	41	105	1
55	Milford,	14,088	–	–	1	1	6	1	21	–	43	42	155	3
56	Greenfield,	14,028	87	–	2	3	11	1	146	–	19	41	33	1
57	Wakefield,	13,664	4	–	1	1	62	2	30	–	5	15	33	–
58	Plymouth,	13,430	17	–	–	1	39	4	37	1	8	39	33	–
59	Adams,	13,340	3	–	–	–	5	–	–	–	17	10	8	1
60	Clinton,	13,266	6	–	1	–	3	–	39	–	80	30	134	1
61	Webster,	13,242	–	–	–	–	21	1	11	–	28	38	69	3
62	Norwood,	12,879	39	–	1	1	5	–	70	–	15	21	219	6
63	West Springfield,	12,696	8	–	1	1	16	1	4	–	37	32	18	1
64	Danvers,	12,309	7	–	1	1	12	–	187	–	90	47	32	–
65	Dedham,	12,172	21	–	–	–	34	3	5	–	6	13	37	–
66	Natick,	11,924	9	–	1	1	13	1	4	–	63	20	325	3
67	Saugus,	11,625	1	–	–	–	5	–	–	–	–	11	10	1
68	Easthampton,	10,692	2	–	1	1	22	1	1	–	16	14	68	3
69	Athol,	10,582	5	–	–	–	7	1	27	1	11	10	9	–
70	Bridgewater,	10,468	5	–	2	1	10	1	47	–	21	29	2	–
71	Winchester,	10,451	62	–	2	–	2	–	86	–	24	9	231	9
72	Braintree,	10,162	14	–	1	–	20	–	31	–	7	24	251	1
73	Palmer,	10,019	–	–	–	–	24	2	1	–	2	14	12	–
74	Towns, 5,000–10,000.	*346,607*	*310*	*1*	*24*	*12*	*335*	*25*	*1558*	*1*	*589*	*734*	*2390*	*25*
75	Belmont,	9,711	10	–	1	–	11	–	99	–	17	16	121	–
76	Ware,	9,694	–	–	–	1	6	1	18	–	7	13	12	–
77	Northbridge,	9,540	–	–	2	1	9	2	15	1	10	21	33	2
78	North Attleborough,	9,503	4	–	–	–	32	–	–	–	35	20	13	–
79	Milton,	9,033	31	–	1	–	16	–	67	–	19	9	67	1
80	Middleborough,	8,898	24	–	–	–	–	1	44	–	34	12	34	1
81	Montague,	8,605	4	–	1	2	6	2	5	–	16	46	76	5
82	Andover,	8,412	12	–	3	–	7	–	196	–	13	10	112	1
83	Swampscott;	8,077	6	–	1	–	6	–	79	–	6	13	112	3
84	Marblehead,	7,779	7	–	–	–	2	–	61	–	3	7	7	–
85	Stoneham,	7,745	1	–	–	–	7	1	4	–	11	11	129	–
86	Amesbury,	7,677	1	–	–	–	25	2	21	–	32	35	1	–
87	Whitman,	7,667	15	–	–	–	–	–	20	–	17	28	6	–
88	Needham,	7,514	13	–	–	–	4	–	7	–	12	22	78	–
89	Reading,	7,438	8	1	–	–	5	1	6	–	3	8	5	–
90	Stoughton,	7,409	–	–	–	–	4	–	2	–	–	17	51	1
91	Rockland,	7,167	8	–	–	–	15	5	33	–	20	10	15	–
92	Wellesley,	7,097	15	–	1	–	24	–	225	–	27	5	227	1
93	Ludlow,	7,088	1	–	1	1	6	1	3	–	16	10	73	1
94	Great Barrington,	7,076	–	–	2	–	8	–	1	–	17	18	43	–
95	Fairhaven,	7,018	2	–	–	–	2	1	2	–	11	12	9	–
96	Maynard,	7,014	–	–	–	1	4	1	13	–	–	13	4	–
97	Franklin,	6,953	9	–	–	1	–	–	33	–	11	8	27	–
98	Concord,	6,848	15	–	2	–	6	–	18	–	–	36	36	–
99	Hudson,	6,768	–	–	1	–	4	–	–	–	–	23	51	1
100	Ipswich,	6,590	1	–	–	–	4	–	7	–	3	5	17	–
101	Grafton,	6,579	–	–	–	–	10	3	2	–	3	25	1	–
102	Tewksbury,	6,237	–	–	–	–	1	–	–	–	–	1	–	–
103	Westborough,	6,233	–	–	–	–	7	–	20	–	29	17	144	–

to the Public Health, 1918 — Continued.

19C Mumps.		38A Ophthalmia Neonatorum.		7 Scarlet Fever.		28-29 Tuberculosis, Pulmonary.		30-35 Tuberculosis, Other Forms.		1 Typhoid Fever.		8 Whooping Cough.		100 Septic Sore Throat.		75A Trachoma.		38C Gonorrhœa.		37 Syphilis.		Line No.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
–	–	1	–	15	–	54	24	5	3	3	1	63	7	2	2	–	–	30	–	2	–	44
3	–	24	–	22	–	24	8	–	3	4	1	11	3	3	–	–	–	11	–	–	–	45
4	–	4	–	27	1	41	15	5	5	3	–	103	9	–	–	–	–	8	–	6	–	46
4	–	1	–	11	–	52	21	2	6	4	–	9	1	–	–	–	–	8	–	6	–	47
1	–	1	–	48	–	19	19	–	3	11	–	16	5	–	–	–	–	14	–	2	–	48
9	–	1	–	16	–	23	12	1	5	33	5	7	–	–	–	–	–	6	1	3	1	49
2	–	5	–	8	–	22	12	1	4	9	2	45	3	–	–	–	–	5	–	1	–	50
245	–	8	–	3	–	17	16	4	6	3	–	63	–	3	2	1	–	8	–	3	–	51
1	–	1	–	1	–	26	15	1	1	11	2	–	–	–	–	–	–	12	–	2	–	52
–	–	2	–	8	–	10	5	–	2	3	–	–	1	–	–	–	–	4	–	3	–	53
21	–	4	–	41	–	14	3	–	–	1	–	34	1	1	–	–	–	9	–	1	1	54
–	–	–	–	16	–	20	15	–	3	–	–	30	4	–	–	–	–	5	–	–	–	55
307	–	8	–	36	–	11	4	1	2	1	–	83	7	–	–	–	–	13	–	4	–	56
8	–	–	–	22	–	19	18	1	3	2	–	8	2	–	–	–	–	4	–	3	–	57
1	–	2	–	3	–	18	9	–	4	6	–	18	4	–	–	1	–	7	–	2	1	58
2	–	2	–	17	–	14	12	2	1	4	1	24	3	–	–	–	–	4	–	–	–	59
10	–	–	–	13	–	22	22	1	1	4	1	11	1	–	–	–	–	4	–	3	–	60
1	–	10	–	–	–	24	15	–	1	3	2	32	4	–	–	–	–	17	–	2	–	61
4	–	1	–	11	–	17	10	1	2	3	–	20	–	–	–	–	–	8	–	–	–	62
5	–	3	–	12	–	10	8	–	–	–	–	3	2	–	–	–	–	4	–	–	1	63
111	–	2	–	8	–	9	25	–	2	1	–	1	–	–	–	1	–	7	–	37	3	64
37	–	–	–	11	–	14	8	2	1	1	–	11	2	–	–	–	–	6	–	–	–	65
12	–	2	–	19	–	11	3	1	–	3	–	22	–	–	1	–	–	16	–	14	–	66
1	–	1	–	5	–	8	7	2	–	3	–	4	4	–	–	–	–	3	1	1	2	67
18	–	–	–	5	–	10	6	1	1	–	–	22	2	–	–	–	–	6	–	–	–	68
7	–	1	–	7	–	7	6	2	2	10	–	14	2	–	–	–	–	21	–	2	–	69
4	–	3	–	14	–	3	17	2	6	6	–	28	1	–	–	–	–	5	–	5	1	70
4	–	2	–	4	–	6	3	1	1	1	–	19	1	–	–	–	–	6	–	2	1	71
12	–	2	–	24	1	11	8	1	1	–	–	18	3	–	–	–	–	19	–	2	–	72
8	–	1	–	12	1	9	10	1	2	1	–	–	4	1	1	–	–	4	–	–	–	73
376	*1*	*90*	–	*384*	*5*	*375*	*307*	*33*	*56*	*79*	*9*	*725*	*52*	*9*	*1*	*2*	–	*201*	–	*52*	*10*	74
3	–	1	–	7	–	11	7	2	2	2	–	14	2	–	–	1	–	1	–	2	–	75
–	–	–	–	2	–	9	10	–	2	–	–	–	–	–	–	–	–	6	–	–	–	76
–	–	–	–	17	–	7	10	–	1	1	–	–	2	–	–	–	–	8	–	3	–	77
–	–	–	–	11	–	14	7	–	2	1	1	11	2	–	–	–	–	1	–	1	–	78
75	1	1	–	15	–	11	6	–	1	4	–	64	1	–	–	–	–	10	–	–	–	79
1	–	–	–	6	–	9	1	–	–	–	–	58	1	1	1	–	–	6	–	–	–	80
3	–	1	–	54	3	7	8	–	–	1	–	8	1	–	–	–	–	2	–	–	–	81
27	–	1	–	9	–	6	6	–	–	3	–	2	–	–	–	–	–	4	–	–	–	82
6	–	8	–	7	–	3	4	–	–	1	1	10	–	–	–	–	–	5	–	1	–	83
1	–	–	–	4	–	3	4	1	2	1	–	1	9	–	–	–	–	8	–	1	–	84
4	–	1	–	9	–	7	7	1	1	4	–	2	1	–	–	–	–	5	–	2	1	85
–	–	2	–	5	–	7	11	–	1	2	–	1	2	–	–	–	–	9	–	1	–	86
3	–	1	–	19	–	4	7	1	4	1	–	131	–	–	–	–	–	6	–	1	–	87
2	–	1	–	12	–	7	3	1	2	1	–	3	–	–	–	–	–	1	–	2	–	88
–	–	–	–	6	–	12	5	–	2	5	–	–	–	–	–	–	–	2	–	–	–	89
–	–	2	–	5	–	1	4	1	2	–	–	–	2	–	–	–	–	3	–	–	–	90
–	–	–	–	1	–	12	6	–	1	–	–	14	–	–	–	–	–	5	–	3	2	91
26	–	13	–	4	–	4	3	3	–	1	–	39	–	–	–	–	–	5	–	3	–	92
9	–	5	–	12	–	11	11	1	1	1	–	3	1	–	–	–	–	3	–	–	–	93
5	–	–	–	17	–	4	3	2	4	–	–	13	–	–	–	–	–	5	–	3	–	94
1	–	3	–	5	–	18	7	3	3	1	–	4	4	–	–	–	–	–	–	1	–	95
–	–	–	–	1	1	12	4	1	–	–	–	–	2	–	–	–	–	–	–	–	–	96
–	–	2	–	33	1	8	3	–	–	1	–	14	1	–	–	–	–	11	–	1	–	97
8	–	–	–	8	–	6	1	–	1	2	1	3	–	–	–	1	–	–	–	2	–	98
–	–	4	–	1	–	10	2	–	–	1	–	4	–	1	–	–	–	2	–	1	1	99
–	–	–	–	10	–	7	2	–	–	3	1	9	1	–	–	–	–	3	–	–	2	100
–	–	–	–	7	–	26	32	–	3	1	–	3	2	–	–	–	–	3	–	–	2	101
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	102
–	–	–	–	–	–	23	21	1	1	–	–	–	–	–	–	–	–	5	–	1	1	103

Cases and Deaths from Diseases Dangerous

Line No.	Cities and Towns grouped in Order of Population.	Population estimated as of July 1, 1918.	19A Chicken Pox.		61A Ep. Cerebro-spinal Meningitis.		9 Diphtheria.		19B German Measles.		92 Lobar Pneumonia.		6 Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
104	North Andover,	6,229	2	–	1	**2**	2	–	5	–	3	**6**	13	**1**
105	Canton,	6,153	9	–	–	–	12	**1**	49	–	–	**14**	32	–
106	Mansfield,	6,150	14	–	2	–	16	–	192	–	4	**6**	84	**2**
107	Winchendon,	6,056	10	–	2	–	1	–	17	–	10	**7**	26	–
108	Dartmouth,	5,940	6	–	–	–	3	–	–	–	9	**17**	134	**2**
109	Lexington,	5,936	15	–	–	–	7	–	28	–	18	**14**	34	–
110	Walpole,	5,875	18	–	–	–	2	–	37	–	7	**6**	94	–
111	Wareham,	5,866	3	–	–	–	9	**1**	–	–	12	**9**	–	–
112	Amherst,	5,844	5	–	–	–	3	–	56	–	22	**7**	30	–
113	Abington,	5,768	4	–	–	–	19	–	50	–	2	**9**	22	–
114	Millbury,	5,651	–	–	–	–	1	–	–	–	–	**5**	–	–
115	Spencer,	5,516	–	–	1	**1**	–	–	–	–	1	**17**	20	**2**
116	Hingham,	5,456	21	–	–	–	7	**1**	38	–	28	**19**	135	–
117	Orange,	5,440	–	–	–	–	7	**1**	–	–	3	**21**	1	–
118	South Hadley,	5,362	1	–	1	**1**	2	–	11	–	11	**8**	27	–
119	Chelmsford,	5,292	–	–	1	**1**	2	–	25	–	20	**9**	169	–
120	Agawam,	5,232	–	–	–	–	4	–	1	–	9	**15**	3	**1**
121	Barnstable,	5,200	6	–	–	–	1	–	42	–	16	**8**	43	–
122	Monson,	5,161	9	–	–	–	1	–	5	–	42	**43**	18	–
123	Uxbridge,	5,081	–	–	–	–	–	–	1	–	–	**12**	1	–
124	Easton,	5,016	–	–	–	–	4	–	–	–	–	**6**	–	–
125	Randolph,	5,013	–	–	–	–	1	–	–	–	–	**5**	–	–
126	Towns, 2,500–5,000.	*182,889*	*174*	–	*4*	*2*	*155*	*16*	*620*	*1*	*320*	*322*	*985*	*14*
127	Lee,	4,708	1	–	–	**1**	–	–	5	–	58	**3**	1	–
128	Rockport,	4,446	2	–	–	–	–	–	14	–	7	**10**	47	**1**
129	Dudley,	4,441	2	–	–	–	3	–	1	–	9	**8**	6	**2**
130	Falmouth,	4,414	–	–	–	–	9	–	1	–	–	**3**	9	–
131	Dracut,	4,382	1	–	–	–	3	–	–	–	1	**3**	43	–
132	Warren,	4,319	–	–	–	–	1	**2**	–	–	16	**12**	–	–
133	Templeton,	4,290	2	–	–	–	39	**6**	11	–	6	**5**	35	–
134	Provincetown,	4,247	1	–	–	–	–	–	29	**1**	2	**5**	–	–
135	Williamstown,	4,157	4	–	–	–	1	**1**	5	–	–	**5**	1	–
136	Dalton,	4,044	–	–	–	–	1	–	4	–	1	–	1	–
137	East Bridgewater,	3,898	–	–	–	–	1	–	–	–	50	**7**	–	–
138	Auburn,	3,833	4	–	–	–	2	**1**	2	–	1	**9**	1	–
139	Barre,	3,809	6	–	–	–	4	**1**	19	–	–	**4**	4	–
140	Medfield,	3,764	–	–	–	–	3	–	14	–	22	**33**	77	**1**
141	Somerset,	3,749	1	–	–	–	4	–	–	–	8	**11**	2	–
142	Blackstone,	3,695	–	–	1	–	9	–	–	–	–	**11**	–	–
143	Foxborough,	3,685	6	–	–	–	2	**1**	14	–	1	**10**	66	–
144	Hardwick,	3,641	–	–	–	–	–	–	2	–	–	**1**	1	–
145	Oxford,	3,550	2	–	–	–	7	–	14	–	–	**6**	2	**1**
146	Billerica,	3,538	–	–	1	–	–	–	3	–	2	**4**	6	**1**
147	Westport,	3,476	–	–	–	–	–	–	2	–	11	**3**	23	–
148	Leicester,	3,377	1	–	–	–	–	–	–	–	4	**13**	4	**1**
149	Lenox,	3,358	–	–	–	–	3	–	1	–	–	**4**	4	–
150	Shrewsbury,	3,339	–	–	–	–	–	–	1	–	22	**11**	–	–
151	Nantucket,	3,297	11	–	–	–	–	–	4	–	3	–	1	–
152	Manchester,	3,119	30	–	–	–	–	–	94	–	–	**6**	85	–
153	Hadley,	3,093	–	–	–	–	2	–	–	–	2	**6**	–	–
154	Deerfield,	3,079	–	–	–	–	6	–	1	–	1	**9**	2	–
155	West Bridgewater,	3,068	–	–	–	–	1	–	–	–	1	**1**	–	–
156	Hatfield,	3,044	3	–	–	–	5	–	27	–	9	**2**	1	–
157	Holbrook,	3,032	1	–	1	–	–	–	2	–	–	**3**	2	–
158	Seekonk,	3,005	–	–	–	–	1	–	–	–	–	**2**	–	–
159	Hopedale,	2,950	–	–	–	–	4	**1**	2	–	1	**4**	56	**1**
160	Medway,	2,942	–	–	–	–	–	**1**	6	–	–	**4**	9	–
161	Cohasset,	2,938	4	–	–	–	9	–	12	–	8	**4**	58	–
162	Swansea,	2,930	–	–	–	–	–	–	–	–	9	**4**	12	–
163	Pepperell,	2,912	–	–	–	–	–	–	14	–	–	**8**	22	–

to the Public Health, 1918 — Continued.

19C Mumps.		38A Ophthalmia Neonatorum.		7 Scarlet Fever.		28-29 Tuberculosis, Pulmonary.		30-35 Tuberculosis, Other Forms.		1 Typhoid Fever.		8 Whooping Cough.		100 Septic Sore Throat.		75A Trachoma.		38C Gonorrhœa.		37 Syphilis.		Line No.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
–	–	–	–	4	–	2	6	–	–	–	1	–	1	–	–	–	–	–	–	–	–	104
12	–	4	–	8	–	6	7	11	8	–	–	62	–	–	–	–	–	12	–	1	–	105
15	–	15	–	6	–	9	6	–	–	2	–	11	–	3	–	–	–	7	–	3	–	106
16	–	1	–	8	–	8	6	2	2	3	–	56	2	1	–	–	–	3	–	–	–	107
2	–	4	–	5	–	8	9	–	1	3	–	22	–	–	–	–	–	1	–	–	–	108
14	–	–	–	3	–	6	4	1	1	–	–	25	–	–	–	–	–	10	–	3	–	109
3	–	2	–	4	–	3	–	–	–	9	1	1	–	–	–	–	–	8	–	1	–	110
–	–	3	–	9	–	7	3	–	1	1	–	11	5	–	–	–	–	6	–	–	–	111
53	–	10	–	–	–	8	3	–	–	6	1	12	–	–	–	–	–	–	–	–	–	112
20	–	1	–	5	–	3	7	–	1	1	–	33	2	–	–	–	–	1	–	1	–	113
–	–	–	–	1	–	3	3	–	–	2	–	–	–	–	–	–	–	5	–	3	1	114
–	–	–	–	1	–	4	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	115
16	–	1	–	2	–	3	3	1	2	2	–	33	–	–	–	–	–	3	–	–	–	116
1	–	–	–	9	–	4	9	–	–	3	1	–	2	–	–	–	–	–	–	–	–	117
4	–	–	–	1	–	2	4	–	–	–	–	4	1	–	–	–	–	–	–	–	–	118
–	–	1	–	10	–	3	3	–	–	–	–	8	–	–	–	–	–	–	–	–	–	119
2	–	–	–	3	–	1	1	–	1	–	–	1	1	–	–	–	–	–	–	–	–	120
42	–	–	–	14	–	3	2	–	1	2	–	21	–	2	–	–	–	14	–	2	–	121
2	–	–	–	–	–	24	23	–	1	–	–	14	–	1	–	–	–	3	–	6	–	122
–	–	2	–	–	–	2	3	–	–	2	–	–	–	–	–	–	–	1	–	3	–	123
–	–	–	–	4	–	3	5	–	–	3	1	–	1	–	–	–	–	3	–	–	–	124
–	–	–	–	–	–	4	4	–	1	2	–	–	2	–	–	–	–	4	–	–	–	125
201	–	*12*	–	*231*	*5*	*149*	*191*	*7*	*33*	*73*	*9*	*182*	*24*	*11*	–	–	–	*77*	–	*35*	*8*	126
–	–	–	–	2	–	2	5	1	2	5	–	–	–	–	–	–	–	1	–	1	–	127
–	–	2	–	2	–	4	2	2	1	3	1	–	–	–	–	–	–	1	–	–	–	128
–	–	–	–	–	–	–	4	–	–	2	–	1	–	–	–	–	–	3	–	–	–	129
8	–	1	–	–	–	4	2	–	–	–	–	37	–	–	–	–	–	–	–	–	–	130
–	–	–	–	1	–	–	3	–	–	–	–	–	3	–	–	–	–	–	–	1	–	131
–	–	1	–	–	–	1	3	–	–	–	–	1	3	–	–	–	–	3	–	–	–	132
4	–	–	–	2	–	3	1	–	2	–	–	18	2	–	–	–	–	–	–	2	1	133
2	–	2	–	–	–	3	7	–	2	2	–	–	–	–	–	–	–	6	–	1	–	134
3	–	–	–	8	–	4	5	–	2	–	–	–	–	–	–	–	–	3	–	2	–	135
3	–	–	–	10	–	–	1	–	–	–	–	–	–	–	–	–	–	1	–	3	–	136
–	–	1	–	2	–	28	10	–	3	2	–	–	–	–	–	–	–	5	–	–	–	137
–	–	–	–	4	–	1	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	138
11	–	–	–	1	–	2	4	–	–	–	–	5	–	–	–	–	–	–	–	–	–	139
1	–	–	–	7	–	8	35	–	1	–	–	–	–	–	–	–	–	2	–	1	3	140
1	–	1	–	9	–	4	2	–	1	1	–	–	4	–	–	–	–	–	–	–	–	141
–	–	–	–	–	–	2	5	–	2	1	–	–	–	–	–	–	–	1	–	–	–	142
33	–	–	–	2	–	5	8	–	–	3	–	–	–	1	–	–	–	9	–	1	–	143
–	–	–	–	28	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	144
–	–	–	–	–	–	1	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	145
1	–	1	–	23	1	1	2	–	–	2	–	–	1	–	–	–	–	5	–	–	–	146
21	–	–	–	–	–	1	5	–	–	1	–	2	–	–	–	–	–	3	–	–	–	147
–	–	–	–	–	–	–	4	–	1	1	1	–	1	–	–	–	–	2	–	1	–	148
–	–	–	–	3	–	2	5	–	1	1	–	–	–	1	–	–	–	–	–	–	–	149
–	–	–	–	1	1	–	–	–	1	–	–	–	1	–	–	–	–	1	–	–	–	150
–	–	–	–	1	–	2	3	–	–	2	–	–	–	–	–	–	–	–	–	–	–	151
–	–	–	–	5	–	–	2	–	1	–	–	11	–	–	–	–	–	1	–	1	–	152
–	–	–	–	–	–	4	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	153
–	–	–	–	3	–	1	1	–	–	–	–	1	1	–	–	–	–	–	–	–	1	154
–	–	–	–	4	–	1	1	–	–	2	–	–	–	–	–	–	–	–	–	–	–	155
1	–	–	–	5	–	3	2	1	1	–	–	3	–	–	–	–	–	1	–	–	–	156
13	–	–	–	–	–	2	4	–	–	2	1	4	–	–	–	–	–	–	–	1	–	157
–	–	–	–	1	–	1	1	–	–	–	1	–	1	–	–	–	–	–	–	–	–	158
–	–	–	–	3	–	–	1	–	2	–	–	2	–	–	–	–	–	1	–	–	–	159
–	–	–	–	–	–	–	3	–	–	1	–	2	–	–	–	–	–	–	–	–	–	160
1	–	1	–	1	–	1	1	–	1	4	–	7	–	–	–	–	–	1	–	1	–	161
3	–	–	–	2	–	3	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	162
2	–	–	–	4	–	1	3	–	–	1	1	–	–	–	–	–	–	–	–	–	–	163

Cases and Deaths from Diseases Dangerous

Line No.	Cities and Towns grouped in Order of Population.	Population estimated as of July 1, 1918.	19A Chicken Pox.		61A Ep. Cerebrospinal Meningitis.		9 Diphtheria.		19B German Measles.		92 Lobar Pneumonia.		6 Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
164	Hanover,	2,884	2	–	–	–	–	–	–	–	–	8	2	–
165	North Brookfield,	2,864	–	–	–	–	–	–	–	–	–	1	11	–
166	Wrentham,	2,844	23	–	–	–	2	–	118	–	26	4	19	–
167	Holliston,	2,837	1	–	–	–	1	–	14	–	–	4	1	1
168	Westford,	2,837	4	–	–	–	5	–	4	–	6	10	140	1
169	Acushnet,	2,833	–	–	–	1	3	–	1	–	–	9	3	–
170	Bourne,	2,800	10	–	–	–	–	–	–	–	2	12	11	–
171	Scituate,	2,777	2	–	–	–	7	–	6	–	–	6	13	–
172	Ayer,	2,767	5	–	–	–	–	–	62	–	6	7	60	3
173	Holden,	2,749	4	–	–	–	7	1	58	–	19	2	47	–
174	Dighton,	2,669	–	–	–	–	–	–	–	–	1	2	4	–
175	Sutton,	2,669	7	–	1	–	4	1	1	–	1	3	8	–
176	Kingston,	2,667	–	–	–	–	–	–	–	–	–	7	–	–
177	Lancaster,	2,662	16	–	–	–	1	–	26	–	2	2	34	–
178	Wilbraham,	2,643	–	–	–	–	1	–	–	–	1	1	5	–
179	Wilmington,	2,632	16	–	–	–	4	–	17	–	–	3	40	1
180	Norton,	2,616	1	–	–	–	–	–	–	–	1	3	–	–
181	Sharon,	2,570	1	–	–	–	–	–	9	–	–	4	6	–
182	Towns under 2,500.	*212,530*	*284*	–	*4*	*4*	*158*	*9*	*500*	–	*284*	*326*	*1,104*	*19*
183	Weston,	2,493	6	–	–	–	1	–	10	–	3	–	29	–
184	Hopkinton,	2,490	1	–	–	–	–	–	6	–	1	2	76	–
185	Groveland,	2,457	12	–	–	–	–	–	1	–	10	6	16	–
186	Groton,	2,448	–	–	–	–	–	–	–	–	–	2	–	–
187	Hull,	2,409	2	–	–	–	2	–	6	–	6	5	46	–
188	Rehoboth,	2,373	–	–	–	–	–	–	–	–	3	3	3	–
189	Charlton,	2,329	–	–	–	–	2	1	–	–	–	3	27	1
190	Shirley,	2,322	1	–	–	–	8	–	2	–	27	8	74	–
191	Avon,	2,260	55	–	–	–	–	–	–	–	–	3	13	–
192	Harwich,	2,220	–	–	–	–	1	–	1	–	–	4	1	–
193	Ashland,	2,213	1	–	–	–	–	1	31	–	1	4	134	1
194	Douglas,	2,196	4	–	–	–	3	–	4	–	–	3	7	–
195	East Longmeadow,	2,186	–	–	–	–	–	–	3	–	9	5	–	–
196	Acton,	2,161	7	–	–	–	1	–	–	–	–	2	7	–
197	Georgetown,	2,122	5	–	–	–	5	–	1	–	5	6	40	1
198	Bellingham,	2,117	–	–	–	–	–	–	1	–	–	3	10	–
199	Williamsburg,	2,109	2	–	–	–	14	–	–	–	1	1	8	–
200	Duxbury,	2,071	8	–	–	–	–	–	15	–	–	1	2	–
201	Belchertown,	2,068	–	–	–	–	13	–	–	–	–	2	4	–
202	Merrimac,	2,037	–	–	–	–	1	–	–	–	13	11	7	1
203	Ashburnham,	2,027	–	–	–	–	1	–	20	–	15	3	29	2
204	Millville,	2,026	–	–	–	–	2	–	–	–	7	–	–	–
205	Upton,	2,014	1	–	–	–	2	–	4	–	4	2	41	1
206	Southborough,	1,997	5	–	–	–	2	–	–	–	–	3	36	–
207	Rutland,	1,992	–	–	–	–	–	–	–	–	–	7	1	–
208	Brookfield,	1,966	–	–	–	–	–	–	35	–	6	3	–	–
209	Hamilton,	1,962	–	–	–	–	–	–	–	–	–	2	3	–
210	Wayland,	1,921	–	–	1	–	1	1	7	–	–	4	8	–
211	Sheffield,	1,891	2	–	–	–	–	–	–	–	6	2	1	–
212	Colrain,	1,886	–	–	–	–	–	–	–	–	1	2	1	–
213	Stockbridge,	1,881	2	–	–	–	1	–	3	–	2	–	8	–
214	Northfield,	1,872	–	–	–	–	8	–	21	–	–	5	9	–
215	Sherborn,	1,869	–	–	–	–	1	–	8	–	5	1	5	–
216	Raynham,	1,865	–	–	–	–	–	–	–	–	1	2	4	–
217	Northborough,	1,851	1	–	1	1	1	–	2	–	–	2	12	–
218	Longmeadow,	1,846	3	–	–	–	2	–	13	–	1	2	9	–
219	Townsend,	1,844	5	–	–	–	1	–	–	–	–	–	4	–
220	Freetown,	1,785	3	–	–	–	–	–	–	–	1	–	–	–
221	Dennis,	1,761	–	–	–	–	–	–	6	–	3	1	–	–
222	Hanson,	1,758	–	–	1	1	1	–	–	–	–	1	–	–
223	Salisbury,	1,755	–	–	–	–	–	–	–	–	1	2	6	1

to the Public Health, 1918 — Continued.

19C Mumps.		38A Ophthalmia Neonatorum.		7 Scarlet Fever.		28-29 Tuberculosis, Pulmonary.		30-35 Tuberculosis, Other Forms.		1 Typhoid Fever.		8 Whooping Cough.		100 Septic Sore Throat.		75A Trachoma.		38C Gonorrhœa.		37 Syphilis.		Line No.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
–	–	–	–	–	–	–	2	–	–	1	–	16	–	–	–	–	–	5	–	1	1	164
–	–	–	–	–	–	1	3	–	–	15	1	–	1	–	–	–	–	–	–	–	–	165
–	–	–	–	1	–	6	4	–	–	1	–	–	–	–	–	–	–	2	–	–	–	166
–	–	–	–	99	1	1	3	–	–	–	–	–	–	9	–	–	–	–	–	1	–	167
–	–	–	–	–	–	7	3	–	–	–	–	1	1	–	–	–	–	1	–	3	–	168
1	–	1	–	–	–	5	1	–	1	–	–	–	–	–	–	–	–	1	–	–	–	169
20	–	–	–	1	–	3	9	–	–	–	–	5	–	–	–	–	–	6	–	3	1	170
3	–	–	–	11	–	1	2	–	–	1	–	5	–	–	–	–	–	2	–	–	–	171
2	–	–	–	1	–	3	–	–	–	3	–	11	–	–	–	–	–	9	–	6	–	172
9	–	–	–	23	–	3	–	2	2	1	–	3	–	–	–	–	–	–	–	1	–	173
–	–	–	–	1	–	3	5	1	1	1	2	–	–	–	–	–	–	–	–	2	–	174
–	–	1	–	–	–	5	1	–	–	–	–	15	2	–	–	–	–	–	–	1	–	175
–	–	–	–	–	–	1	1	–	1	1	–	–	–	–	–	–	–	–	–	1	–	176
53	–	–	–	–	–	2	2	–	2	1	–	24	–	–	–	–	–	–	–	–	–	177
4	–	–	–	2	–	–	3	–	1	–	–	–	–	–	–	–	–	–	–	–	–	178
–	–	–	–	3	–	–	2	–	1	10	1	–	–	–	–	–	–	1	–	–	–	179
–	–	–	–	–	–	–	3	–	–	1	–	–	–	–	–	–	–	–	–	–	1	180
1	–	–	–	5	–	11	4	–	–	1	–	7	1	–	–	–	–	–	–	–	–	181
177	–	*11*	–	*265*	*5*	*141*	*392*	*9*	*18*	*50*	*5*	*292*	*23*	*7*	*2*	–	–	*544*	–	*222*	*6*	182
–	–	–	–	1	–	3	2	1	1	2	–	42	–	–	–	–	–	2	–	–	–	183
–	–	–	–	2	–	3	6	–	–	–	–	–	–	–	–	–	–	2	–	–	1	184
–	–	–	–	2	–	6	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	185
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	186
17	–	–	–	8	1	4	1	–	–	1	–	4	–	3	–	–	–	4	–	–	–	187
1	–	–	–	2	1	–	1	–	–	–	–	4	1	–	–	–	–	–	–	–	–	188
–	–	–	–	–	–	3	1	1	–	5	–	–	–	–	–	–	–	–	–	–	–	189
1	–	–	–	3	–	1	2	–	–	–	–	6	–	–	–	–	–	–	–	–	–	190
2	–	–	–	1	–	3	2	–	–	–	–	92	1	–	–	–	–	–	–	–	–	191
–	–	–	–	1	–	3	3	–	–	1	–	–	–	–	–	–	–	1	–	–	–	192
–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	193
–	–	1	–	2	–	2	4	–	2	–	–	3	–	–	–	–	–	7	–	–	–	194
–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	1	–	195
–	–	–	–	5	–	–	1	1	–	–	–	4	3	–	–	–	–	1	–	–	–	196
1	–	–	–	–	–	2	3	–	–	–	–	–	–	–	–	–	–	3	–	2	–	197
–	–	–	–	3	–	1	1	–	–	–	–	8	1	–	–	–	–	–	–	–	–	198
4	–	–	–	2	–	1	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	199
28	–	–	–	–	–	3	1	–	–	1	–	10	–	–	–	–	–	–	–	–	–	200
1	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–	201
–	–	–	–	–	–	–	1	–	2	–	–	11	1	–	–	–	–	1	–	1	1	202
–	–	–	–	2	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	203
–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	204
–	–	–	–	1	–	5	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	205
–	–	–	–	3	–	3	1	–	–	–	–	–	–	–	–	–	–	–	–	1	–	206
–	–	–	–	–	–	–	102	–	1	–	–	–	–	–	–	–	–	–	–	–	–	207
–	–	–	–	–	–	3	2	–	1	3	–	3	–	–	–	–	–	–	–	–	–	208
–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	209
–	–	–	–	–	–	1	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	210
–	–	–	–	2	–	1	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	211
2	–	–	–	30	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	212
1	–	–	–	–	–	–	2	–	1	–	–	4	–	–	–	–	–	–	–	–	–	213
36	–	–	–	2	–	–	–	–	–	–	–	4	–	–	–	–	–	–	–	–	–	214
–	–	–	–	2	–	3	–	–	–	1	1	1	1	–	–	–	–	483	–	213	–	215
–	–	–	–	2	–	4	4	–	1	–	–	–	–	–	–	–	–	–	–	–	–	216
–	–	–	–	6	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	217
4	–	1	–	2	–	1	2	–	–	1	–	3	–	–	–	–	–	1	–	–	2	218
–	–	–	–	–	–	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	219
–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	220
3	–	1	–	4	–	2	2	–	–	–	–	–	–	–	–	–	–	1	–	–	–	221
–	–	–	–	1	–	1	2	1	1	–	–	–	–	–	–	–	–	–	–	1	–	222
–	–	–	–	1	–	–	2	–	–	2	1	–	–	–	–	–	–	–	–	–	–	223

Cases and Deaths from Diseases Dangerous

Line No.	Cities and Towns grouped in Order of Population.	Population estimated as of July 1, 1918.	19A Chicken Pox.		61A Ep. Cerebrospinal Meningitis.		9 Diphtheria.		19B German Measles.		92 Lobar Pneumonia.		6 Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
224	Lunenburg,	1,748	43	–	–	–	–	–	41	–	2	**1**	6	**2**
225	Westminster,	1,748	–	–	–	–	1	–	–	–	–	**4**	–	–
226	Chatham,	1,734	–	–	–	–	1	–	2	–	–	**5**	1	–
227	Carver,	1,726	–	–	–	–	–	–	–	–	–	**2**	–	–
228	Marshfield,	1,716	16	–	–	–	2	**1**	8	–	2	**2**	5	–
229	Lakeville,	1,715	–	–	–	–	1	–	1	–	4	**3**	–	–
230	Essex,	1,713	–	–	–	–	2	–	–	–	–	–	15	–
231	Norwell,	1,662	1	–	–	–	–	–	1	–	5	**6**	6	–
232	Newbury,	1,660	–	–	–	–	–	–	1	–	–	**2**	34	–
233	Southwick,	1,586	–	–	–	–	1	**1**	–	–	–	**3**	1	–
234	Buckland,	1,566	1	–	–	–	4	–	–	–	2	**8**	–	–
235	West Newbury,	1,565	1	–	–	–	1	–	–	–	10	**4**	2	–
236	Westwood,	1,564	–	–	–	–	2	–	–	–	–	–	–	–
237	Cheshire,	1,555	–	–	–	–	–	–	–	–	–	–	–	–
238	Rowley,	1,554	–	–	–	–	–	–	1	–	–	**5**	5	–
239	Nahant,	1,518	2	–	–	–	–	–	8	–	5	**4**	–	–
240	Marion,	1,503	1	–	–	–	–	–	3	–	9	**9**	15	–
241	Shelburne,	1,474	1	–	–	–	8	–	1	–	2	**2**	–	–
242	Millis,	1,470	–	–	–	–	–	–	–	–	–	–	62	–
243	Norfolk,	1,466	2	–	–	–	–	–	2	–	2	**1**	–	–
244	Bedford,	1,451	1	–	–	–	2	–	–	–	–	**1**	2	–
245	North Reading,	1,442	5	–	–	–	–	–	14	–	4	**2**	5	–
246	Sterling,	1,432	–	–	–	–	–	–	15	–	3	**1**	2	–
247	Mattapoisett,	1,429	11	–	–	–	1	–	–	–	2	–	3	–
248	Sunderland,	1,426	–	–	–	–	–	–	–	–	3	**9**	–	–
249	Plainville,	1,424	1	–	–	–	1	–	1	–	–	**3**	–	–
250	Middleton,	1,423	–	–	–	–	1	–	–	–	–	**1**	–	–
251	Yarmouth,	1,412	1	–	–	–	–	–	–	–	1	**2**	1	–
252	Tisbury,	1,407	4	–	–	–	3	–	12	–	9	**4**	8	–
253	Sturbridge,	1,400	1	–	–	–	–	–	–	–	–	**3**	1	–
254	Lincoln,	1,397	–	–	–	–	–	–	–	–	–	–	–	–
255	Huntington,	1,396	–	–	–	–	1	–	–	–	–	**2**	–	–
256	Sandwich,	1,378	2	–	–	–	4	**1**	–	–	2	**4**	4	–
257	West Boylston,	1,350	7	–	–	–	–	–	6	–	–	**6**	4	–
258	Oak Bluffs,	1,348	–	–	–	–	–	–	–	–	2	**3**	–	–
259	Hinsdale,	1,347	–	–	–	–	–	–	–	–	–	**1**	–	–
260	Pembroke,	1,337	–	–	–	–	–	–	–	–	–	–	–	–
261	Edgartown,	1,331	2	–	–	–	–	–	3	–	5	–	–	–
262	Chester,	1,322	–	–	–	–	–	–	–	–	–	**2**	–	–
263	Whately,	1,292	–	–	–	–	6	**1**	–	–	–	**3**	1	–
264	West Stockbridge,	1,280	–	–	–	–	–	–	–	–	–	–	–	–
265	West Brookfield,	1,263	–	–	–	–	–	–	2	–	–	**2**	20	**1**
266	Sudbury,	1,261	4	–	–	–	1	–	–	–	–	**4**	11	–
267	Lynnfield,	1,241	–	–	–	**1**	–	–	–	–	–	–	–	–
268	Littleton,	1,228	20	–	–	–	1	–	6	–	3	–	5	–
269	Orleans,	1,224	–	–	–	–	1	–	10	–	2	**1**	22	–
270	Conway,	1,214	–	–	–	–	1	–	1	–	–	**4**	1	–
271	Rochester,	1,205	–	–	–	–	1	–	–	–	–	–	–	–
272	Russell,	1,194	–	–	–	–	–	–	–	–	1	**1**	1	–
273	Erving,	1,181	1	–	–	–	1	–	10	–	7	**6**	2	–
274	Lanesborough,	1,179	–	–	–	–	–	–	–	–	–	–	–	–
275	Topsfield,	1,173	–	–	–	–	–	–	7	–	1	**2**	1	–
276	Harvard,	1,149	1	–	–	–	–	**1**	–	–	3	**8**	5	**6**
277	Stow,	1,134	–	–	–	**1**	–	–	–	–	–	**5**	24	–
278	Dover,	1,128	1	–	–	–	–	–	2	–	–	–	4	–
279	Wenham,	1,106	–	–	–	–	–	–	–	–	–	**1**	–	–
280	Hubbardston,	1,091	–	–	–	–	2	–	–	–	4	**1**	1	–
281	Tyngsborough,	1,056	–	–	–	–	–	–	4	–	4	–	3	–
282	Clarksburg,	1,054	–	–	–	–	–	–	–	–	–	**1**	–	–
283	Ashfield,	1,016	–	–	–	–	–	–	–	–	–	–	–	–
284	Southampton,	1,001	1	–	–	–	–	–	–	–	–	**1**	2	–
285	Becket,	982	–	–	–	–	2	–	–	–	2	**3**	–	–
286	Brimfield,	978	–	–	–	–	–	–	1	–	1	**1**	1	–

to the Public Health, 1918 — Continued.

19C Mumps.		38A Ophthalmia Neonatorum.		7 Scarlet Fever.		28-29 Tuberculosis, Pulmonary.		30-35 Tuberculosis, Other Forms.		1 Typhoid Fever.		8 Whooping Cough.		100 Septic Sore Throat.		75A Trachoma.		38C Gonorrhœa.		37 Syphilis.		Line No.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	224
–	–	–	–	–	–	–	–	–	–	2	–	–	1	–	–	–	–	–	–	–	–	225
–	–	1	–	1	–	–	–	–	–	–	–	1	2	–	–	–	–	–	–	–	–	226
–	–	–	–	–	–	2	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	227
3	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	228
–	–	–	–	1	–	1	92	–	–	1	–	1	–	–	–	–	–	–	–	–	1	229
–	–	–	–	3	–	–	3	–	–	–	–	4	–	–	–	–	–	–	–	1	–	230
–	–	1	–	–	–	1	2	–	–	–	–	5	–	–	–	–	–	–	–	–	–	231
–	–	–	–	4	1	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	232
–	–	–	–	–	–	–	1	–	–	2	1	–	–	–	–	–	–	–	–	–	–	233
–	–	–	–	4	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	234
1	–	–	–	1	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	235
–	–	–	–	–	–	1	2	1	1	–	–	–	1	–	–	–	–	–	–	–	–	236
–	–	–	–	4	1	4	5	–	–	1	–	–	–	–	–	–	–	1	–	–	–	237
–	–	–	–	–	–	1	1	–	–	12	1	2	–	–	–	–	–	–	–	–	–	238
–	–	–	–	–	–	–	1	–	–	1	–	–	1	–	–	–	–	–	–	–	–	239
–	–	–	–	8	–	3	1	–	–	–	–	3	–	–	–	–	–	–	–	–	–	240
–	–	–	–	8	–	3	2	–	–	–	–	–	–	–	–	–	–	4	–	–	–	241
–	–	–	–	–	–	2	5	–	–	–	–	–	–	–	–	–	–	1	–	–	–	242
–	–	–	–	2	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	1	–	243
1	–	–	–	4	–	–	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	244
–	–	–	–	5	–	2	55	–	–	1	–	–	–	–	–	–	–	2	–	–	–	245
–	–	1	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	246
4	–	–	–	2	–	1	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	247
–	–	–	–	–	–	1	–	–	–	–	–	5	–	–	–	–	–	–	–	–	–	248
–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	1	–	–	1	249
–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	250
–	–	1	–	1	–	2	1	–	1	–	–	–	–	–	–	–	–	2	–	–	–	251
–	–	–	–	–	–	13	–	–	–	–	–	6	–	–	–	–	–	–	–	–	–	252
–	–	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	3	–	–	–	253
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	254
–	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	255
2	–	–	–	–	–	2	1	1	1	–	–	1	–	–	1	–	–	4	–	–	–	256
–	–	–	–	–	–	1	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–	257
–	–	–	–	1	–	3	2	–	1	1	–	1	–	–	–	–	–	–	–	–	–	258
–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	259
–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	260
–	–	–	–	–	–	4	2	–	–	2	–	1	–	–	–	–	–	2	–	–	–	261
–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	262
–	–	–	–	–	–	–	1	–	–	–	–	–	2	–	–	–	–	–	–	–	–	263
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	264
3	–	–	–	1	–	1	4	–	1	1	1	–	2	–	–	–	–	–	–	–	–	265
–	–	–	–	1	–	–	1	–	–	1	–	–	1	–	–	–	–	–	–	–	–	266
–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	267
2	–	–	–	–	–	2	2	–	–	–	–	9	–	–	–	–	–	–	–	–	–	268
1	–	–	–	6	–	2	–	–	–	1	–	2	–	–	–	–	–	1	–	–	–	269
–	–	–	–	2	–	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	270
–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	271
–	–	–	–	1	–	–	–	–	–	3	–	4	–	–	–	–	–	–	–	–	–	272
42	–	–	–	21	–	1	1	–	–	–	–	6	–	–	–	–	–	–	–	–	–	273
–	–	–	–	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	274
1	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	275
–	–	–	–	–	–	–	–	–	–	–	–	6	–	–	–	–	–	–	–	–	–	276
1	–	–	–	2	–	2	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	277
1	–	–	–	1	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	278
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	279
–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	280
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	281
–	–	–	–	1	–	–	4	–	–	–	–	7	1	–	–	–	–	–	–	–	–	282
–	–	–	–	2	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	283
–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	284
–	–	–	–	6	–	2	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	285
–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	286

Cases and Deaths from Diseases Dangerous

Line No.	Cities and Towns grouped in Order of Population.	Population estimated as of July 1, 1918.	19A Chicken Pox.		61A Ep. Cerebrospinal Meningitis.		9 Diphtheria.		19B German Measles.		92 Lobar Pneumonia.		6 Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
287	Berkley,	976	–	–	–	–	–	–	–	–	–	–	–	–
288	New Marlborough,	969	–	–	–	–	–	–	–	–	2	–	8	–
289	Mendon,	968	–	–	–	–	–	–	–	–	–	**2**	–	–
290	Charlemont,	961	–	–	–	–	–	–	–	–	4	**3**	–	–
291	Gill,	957	–	–	–	–	1	–	105	–	–	**2**	3	–
292	Ashby,	945	–	–	–	–	15	–	2	–	–	**3**	–	–
293	Royalston,	907	–	–	–	–	–	–	6	–	–	–	–	–
294	Wellfleet,	881	2	–	–	–	–	–	1	–	6	–	–	–
295	Brewster,	880	–	–	–	–	–	–	–	–	–	–	2	–
296	Granby,	870	–	–	–	–	–	–	–	–	–	**2**	–	–
297	Burlington,	854	–	–	–	–	–	–	–	–	2	**1**	9	–
298	Berlin,	838	–	–	–	–	1	–	–	–	–	–	1	–
299	Boylston,	828	–	–	–	–	–	–	–	–	4	**3**	–	–
300	Bernardston,	822	–	–	–	–	–	–	–	–	1	–	–	–
301	Leverett,	811	–	–	–	–	–	–	–	–	2	**4**	12	–
302	Princeton,	788	–	–	–	–	1	–	–	–	2	**2**	–	–
303	Granville,	787	–	–	–	–	–	–	–	–	–	**1**	–	–
304	Bolton,	771	2	–	–	–	–	–	3	–	–	**1**	7	–
305	Enfield,	762	3	–	–	–	–	–	1	–	1	**2**	3	**1**
306	Boxford,	711	–	–	1	–	–	–	1	–	2	**3**	–	–
307	Petersham,	708	–	–	–	–	–	–	3	–	–	–	1	–
308	Dana,	696	–	–	–	–	1	–	–	–	1	–	–	–
309	Halifax,	695	–	–	–	–	–	–	–	–	–	–	–	–
310	Hampden,	686	–	–	–	–	1	**1**	1	–	2	**1**	1	–
311	Cummington,	676	–	–	–	–	–	–	–	–	–	–	–	–
312	Truro,	669	–	–	–	–	1	–	8	–	2	**2**	–	–
313	Worthington,	650	–	–	–	–	–	–	–	–	–	–	–	–
314	Plympton,	624	–	–	–	–	–	–	–	–	–	–	–	–
315	New Salem,	616	–	–	–	–	1	–	–	–	–	–	2	–
316	Egremont,	596	–	–	–	–	–	–	–	–	–	–	8	–
317	Chesterfield,	575	5	–	–	–	–	–	–	–	–	–	18	–
318	Sandisfield,	563	–	–	–	–	–	–	–	–	–	–	–	–
319	Blandford,	562	–	–	–	–	3	–	–	–	1	**2**	18	**1**
320	Eastham,	562	–	–	–	–	–	–	–	–	–	**3**	–	–
321	Hancock,	546	–	–	–	–	–	–	–	–	–	–	–	–
322	Savoy,	538	–	–	–	–	–	–	–	–	–	–	–	–
323	Pelham,	519	–	–	–	–	–	–	1	–	2	–	–	–
324	Oakham,	511	–	–	–	–	–	–	2	–	–	**1**	1	–
325	Richmond,	509	–	–	–	–	1	–	–	–	–	–	–	–
326	Paxton,	506	–	–	–	–	–	–	–	–	–	**1**	–	–
327	Warwick,	477	–	–	–	–	–	–	–	–	–	–	–	–
328	Carlisle,	451	–	–	–	–	–	–	–	–	1	**1**	–	–
329	Florida,	447	–	–	–	–	–	–	–	–	–	–	–	–
330	New Braintree,	446	–	–	–	–	–	–	–	–	–	**1**	4	–
331	West Tisbury,	444	1	–	–	–	3	–	2	–	1	–	–	–
332	Westhampton,	434	–	–	–	–	–	–	–	–	–	**1**	1	–
333	Hawley,	430	–	–	–	–	–	–	–	–	–	–	–	–
334	Greenwich,	410	7	–	–	–	–	–	–	–	1	**3**	8	–
335	Otis,	410	–	–	–	–	–	–	–	–	–	–	–	–
336	Heath,	406	1	–	–	–	–	–	–	–	–	–	–	–
337	Rowe,	404	6	–	–	–	–	–	–	–	2	**2**	–	–
338	Phillipston,	367	–	–	–	–	–	–	–	–	–	–	–	–
339	Leyden,	357	–	–	–	–	–	–	1	–	3	**1**	–	–
340	Plainfield,	356	–	–	–	–	–	–	–	–	–	–	–	–
341	Windsor,	356	–	–	–	–	–	–	–	–	–	–	–	–
342	Monterey,	339	–	–	–	–	–	–	–	–	1	–	–	–
343	Dunstable,	333	–	–	–	–	1	–	–	–	–	–	–	–
344	Boxborough,	332	–	–	–	–	–	–	–	–	–	**1**	2	–
345	Wales,	331	–	–	–	–	2	–	–	–	–	**2**	6	–
346	Monroe,	328	–	–	–	–	–	–	–	–	–	–	1	–
347	Wendell,	315	–	–	–	–	–	–	–	–	2	**2**	–	–
348	Shutesbury,	308	–	–	–	–	–	–	–	–	1	**1**	1	–
349	Middlefield,	306	–	–	–	–	–	–	–	–	–	–	–	–

to the Public Health, 1918 — Continued.

19C Mumps.		38A Ophthalmia Neonatorum.		7 Scarlet Fever.		28-29 Tuberculosis, Pulmonary.		30-35 Tuberculosis, Other Forms.		1 Typhoid Fever.		8 Whooping Cough.		100 Septic Sore Throat.		75A Trachoma.		38C Gonorrhœa.		37 Syphilis.		
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Line No.
–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	287
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	288
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	289
–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	290
3	–	–	–	31	–	–	–	–	–	–	–	6	–	2	–	–	–	–	–	–	–	291
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	292
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	293
–	–	–	–	1	–	2	1	–	–	–	–	1	–	–	–	–	–	1	–	–	–	294
–	–	–	–	8	–	1	2	–	–	–	–	–	–	–	1	–	–	1	–	–	–	295
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	296
–	–	–	–	1	–	3	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	297
1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	298
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	299
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	300
–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	301
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	302
–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	303
–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	304
1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	305
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	306
–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	307
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	308
–	–	1	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	309
–	–	–	–	6	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	310
–	–	–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	311
–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	312
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	313
–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	314
–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	315
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	316
–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	317
–	–	–	–	5	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	318
–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	319
–	–	–	–	–	–	1	1	–	–	–	–	3	–	–	–	–	–	–	–	–	–	320
–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	321
2	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	322
–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	323
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	324
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	325
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2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	332
–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	333
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–	–	–	–	7	–	–	–	–	1	–	–	7	–	–	–	–	–	–	–	–	–	338
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1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	348
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Cases and Deaths from Diseases Dangerous

Line No.	Cities and Towns grouped in Order of Population.	Population estimated as of July 1, 1918.	19A Chicken Pox.		61A Ep. Cerebrospinal Meningitis.		9 Diphtheria.		19B German Measles.		92 Lobar Pneumonia.		6 Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
350	Goshen,	295	–	–	–	–	–	–	–	–	–	–	–	–
351	Tyringham,	293	–	–	–	–	–	–	–	–	2	–	–	–
352	Chilmark,	292	–	–	–	–	–	–	–	–	–	1	–	–
353	Prescott,	286	–	–	–	–	–	–	–	–	2	2	1	–
354	Washington,	274	–	–	–	–	–	–	–	–	–	1	–	–
355	Alford,	268	–	–	–	–	–	–	–	–	–	–	16	–
356	Mashpee,	260	–	–	–	–	–	–	–	–	–	–	–	–
357	Montgomery,	239	–	–	–	–	–	–	–	–	–	1	–	–
358	Tolland,	212	–	–	–	–	–	–	–	–	–	–	–	–
359	Gay Head,	184	–	–	–	–	–	–	–	–	–	–	–	–
360	Peru,	169	–	–	–	–	–	–	–	–	–	–	–	–
361	Holland,	168	–	–	–	–	–	–	–	–	–	–	2	–
362	Gosnold,	158	–	–	–	–	–	–	–	–	–	–	–	–
363	New Ashford,	92	–	–	–	–	–	–	–	–	–	–	–	–
364	Mount Washington,	85	–	–	–	–	–	–	–	–	–	–	1	–
365	Camp Devens,	–	9	–	25	7	24	2	84	–	2584	720	907	6
366	State Infirmary,	–	44	1	–	–	18	–	–	–	12	18	82	15

In addition to the above there occurred 1 case of actinomycosis: —

	Cases.	Deaths.
Attleboro,	1	–

99 cases of anterior poliomyelitis, with 38 deaths: —

Barre,	1	–
Belmont,	1	–
Beverly,	1	1
Boston,	14	10
Braintree,	1	1
Brockton,	1	1
Cambridge,	5	2
Chelsea,	1	1
Cohasset,	1	–
Dedham,	2	1
Dracut,	1	–
Easthampton,	1	–
Everett,	1	–
Fairhaven,	1	–
Fall River,	2	–
Framingham,	3	1
Hadley,	1	–
Halifax,	1	–
Haverhill,	2	–
Holyoke,	5	1
Hopedale,	2	1
Lowell,	8	4
Malden,	1	1
Marlborough,	–	1
Medford,	3	–
Mendon,	1	1
Methuen,	1	–
Milford,	2	1
New Bedford,	11	–
Newton,	1	1
Northampton,	3	–
Quincy,	1	–
Revere,	2	1
Shirley,	1	–
Somerville,	3	–
Springfield,	4	1
Sterling,	1	1
Sutton,	–	1
Taunton,	1	–
Tewksbury,	–	1
Tewksbury State Infirmary,	–	1
Topsfield,	1	1
Ware,	1	–
Warren,	1	–
Wellesley,	–	1
Whately,	1	–
Whitman,	1	–
Winthrop,	1	–
Worcester,	1	1

23 cases of anthrax, with 7 deaths: —

Athol,	–	1
Camp Devens,	1	–
Bolton,	1	–
Boston,	3	–
Brockton,	1	1
Chicopee,	1	–
Haverhill,	2	–
Lawrence,	1	1
Lowell,	2	–
Lynn,	1	1
Methuen,	1	1
Peabody,	1	–
Quincy,	–	1
Salem,	1	–
Springfield,	–	1
Winchendon,	3	–
Winchester,	1	–
Woburn,	3	–

to the Public Health, 1918 — Concluded.

19C Mumps.		38A Ophthalmia Neonatorum.		7 Scarlet Fever.		28–29 Tuberculosis, Pulmonary.		30–35 Tuberculosis, Other Forms.		1 Typhoid Fever.		8 Whooping Cough.		100 Septic Sore Throat.		75A Trachoma.		38C Gonorrhœa.		37 Syphilis.		Line No.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	350
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	351
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–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	353
–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	354
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	355
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1011	–	–	–	45	1	1	3	–	2	5	–	–	–	–	–	–	–	508	–	408	3	365
–	1	3	–	–	–	146	253	16	11	2	–	3	–	–	–	–	–	108	–	46	26	366

20 cases of dog bite (requiring antirabic treatment). On final investigation it was found that in only three cases was Pasteur treatment necessary.

	Cases.	Deaths.
Attleboro,	1	–
Barre,	3	–
Boston,	3	–
Charleton,	1	–
Clinton,	1	–
Lawrence,	1	–
Lowell,	1	–
Methuen,	1	–
North Attleborough,	3	–
Taunton,	2	–
Ware,	1	–
Worcester,	2	–

79 cases of dysentery, with 75 deaths: —

Adams,	1	–
Amesbury,	–	2
Andover,	1	–
Attleboro,	–	1
Beverly,	1	1
Bernardston,	–	1
Blackstone,	–	1
Boston,	11	4
Bridgewater,	–	1
Cambridge,	1	3
Chelsea,	–	1
Chicopee,	–	2
Danvers,	1	–
Dartmouth,	6	1
Dedham,	–	2
Dracut,	–	2
Easthampton,	–	3
Essex,	2	–
Fall River,	1	3
Gardner,	–	1
Greenfield,	2	–
Hamilton,	1	–
Haverhill,	–	1
Holyoke,	–	2
Ipswich,	2	–
Lawrence,	1	2
Leominster,	–	2
Lowell,	–	3
Malden,	–	2
Medfield,	7	1
Medway,	–	1
Melrose,	7	2
Middleborough,	2	–
Milford,	–	1
Montague,	–	1
New Bedford,	3	2
Newburyport,	1	2
North Adams,	2	3
Northampton,	–	2
Pelham,	1	1
Princeton,	–	1
Rowley,	–	1
Salem,	–	2
Scituate,	–	1
Shirley,	7	–
Somerville,	4	1
Springfield,	–	2
Sutton,	8	–
Swampscott,	–	1
Taunton,	–	3
Wakefield,	–	1
Waltham,	–	2
Wellesley,	–	1
Whitman,	–	1
Woburn,	–	1
Worcester,	6	–

3 cases of leprosy: —	Cases.	Deaths.
Boston,	3	–
82 cases of malaria, with 4 deaths: —		
Camp Devens,	10	–
Blackstone,	3	–
Boston,	13	–
Bridgewater,	1	–
Cambridge,	1	–
Dedham,	7	–
Erving,	3	–
Fall River,	3	–
Lynn,	5	–
Mansfield,	1	–
Melrose,	–	1
Natick,	4	–
Newton,	1	1
Pittsfield,	1	–
Springfield,	1	1
Uxbridge,	28	–
Westfield,	–	1
19 cases of pellagra, with 22 deaths: —		
Boston,	2	3
Boxford,	1	–
Cambridge,	1	–
Chelsea,	–	1
Danvers,	–	3
Everett,	1	1
Fall River,	–	1
Foxborough,	2	1
Gardner,	–	1
Leominster,	1	–
Lowell,	–	1
Lynn,	1	1
Middleton,	–	1
Northampton,	4	3
Somerville,	1	–
Stoneham,	–	1
Taunton,	1	–
Waltham,	1	1
Worcester,	3	3
27 cases of smallpox: —		
Camp Devens,	1	–
Boston,	6	–
Chelsea,	1	–
Gloucester,	2	–
Hardwick,	1	–
Lowell,	2	–
Lynn,	1	–
Marlborough,	6	–
Milton,	1	–
Natick,	1	–
Tewksbury State Infirmary,	2	–
Tisbury,	1	–
West Springfield,	2	–

27 cases of tetanus, with 32 deaths: —	Cases.	Deaths.
Andover,	–	1
Beverly,	1	–
Boston,	3	1
Brockton,	1	–
Cambridge,	2	–
Chesterfield,	1	–
Clinton,	–	1
Concord,	–	1
East Bridgewater,	–	1
Fall River,	1	1
Gloucester,	1	1
Great Barrington,	1	–
Lawrence,	2	3
Lowell,	–	1
Lynn,	–	1
Malden,	–	1
Mansfield,	–	1
Marion,	1	–
Northampton,	–	1
Peabody,	1	1
Pittsfield,	–	2
Plymouth,	1	1
Provincetown,	–	1
Salem,	2	3
Springfield,	1	1
Sudbury,	1	–
Taunton,	1	2
Wakefield,	1	–
Winchester,	–	1
Worcester,	5	5
15 cases of trichinosis: —		
Brockton,	5	–
Hingham,	1	–
Lynn,	1	–
Northampton,	8	–
2 cases of typhus, with 1 death: —		
Boston,	–	1
Chelsea,	2	–

Influenza was added to the list of reportable diseases on Oct. 4, 1918. From that date until the close of the year there were reported 145,262 cases, with 11,100 deaths. The distribution by months was as follows: —

October,	88,494	8,274
November,	14,750	1,022
December,	42,018	1,804

Division of Biologic Laboratories.

Milton J. Rosenau, M.D., *Director.*

Report of Division of Biologic Laboratories.

The work of the Division of Biologic Laboratories was carried out in the face of unusual difficulties during the fiscal year 1918. This was caused by increased activities, increased demand for products, changes in personnel, the difficulty in obtaining certain supplies and the strain of finances caused by war conditions. Several emergencies had to be met which taxed the capacity of the laboratories to their utmost. There was a sudden and unusual demand for diphtheria antitoxin during the summer, for vaccine virus in the spring and for anti-meningitis serum during the cold season. The principal new activity of the Division consisted in the testing of arsphenamine.

The changes in personnel at the Antitoxin and Vaccine Laboratory at Forest Hills, caused by war conditions, became a matter of deep concern when the nature and importance of the products made at that laboratory are taken into account. The financial situation was bothersome throughout the fiscal year, for it soon became evident that even with the strictest economy it would be impossible to make the budget meet the increasing cost of labor and supplies.

As an example of the difficulties the laboratories had to contend with, we may cite the fact that it has become impossible to obtain dialyzing paper for the purpose of concentrating diphtheria antitoxin. This paper was formerly made in Belgium, and since this source of supply has been cut off, it has become practically unavailable.

The following is a summary of the work done both at the Antitoxin and Vaccine Laboratory at Forest Hills, and the Wassermann Laboratory at Boston: —

Antitoxin and Vaccine Laboratory.

	1918.	1917.
Vaccine virus, doses,	217,650	180,521
Typhoid prophylactic, doses,	24,578	71,893
Paratyphoid vaccine, doses,	1,950	2,723
Typhoid-paratyphoid vaccine, doses,	25,263	16,143
Diphtheria antitoxin, doses,	183,039	218,604
Anti-meningitis serum, bottles,	4,558	2,005
Anti-pneumococcus serum: —		
Type I, bottles,	357	60
Type II, bottles,	295	97
Schick outfits, bottles,	9,450	3,100
Toxin-antitoxin mixture, doses,	476	–

Wassermann Laboratory.

	1918.	1917.
Wassermann tests,	27,534	28,524
Complement fixation tests for glanders,	646	1,330
Agglutination tests for glanders,	215	423
Diagnostic examinations for rabies,	61	67
Miscellaneous, pathological and bacteriological examinations,	45	3

Institutions and Physicians served and the Number of Specimens for Wassermann Test from these Sources.

	Number of Institutions and Physicians served.				Number of Specimens.			
	1914-15 (6 Months).	1915-16	1916-17	1917-18	1914-15 (6 Months).	1915-16	1916-17	1917-18
Institutions,	42	74	89	91	6,350	23,101	24,735	23,008
Physicians,	110	514	764	985	142	2,396	3,789	4,526
Total,	–	–	–	–	6,492	25,497	28,524	27,534

Diagnostic Examinations for the Department of Animal Industry.

	1915-16 (8 Months).	1916-17 (12 Months).	1917-18 (12 Months).
Complement fixation tests for glanders,	985	1,330	646
Agglutination tests for glanders,	–	423	215
Diagnostic examinations for rabies,	47	67	61
Miscellaneous, pathologic and bacteriologic examinations,	10	3	45
Total,	1,042	1,823	967

Diphtheria antitoxin was produced at 6.5 cents per 1000 units; antimeningitis serum, 50.5 cents per 15 cubic centimeters; pneumococcus serum, $4.10 per 100 cubic centimeters; diphtheria toxin for Schick test, 8.3 cents per .01 cubic centimeter; toxin-antitoxin mixture, 14.4 cents per cubic centimeter (one dose); vaccine virus, 4.2 cents per one-sixtieth cubic centimeter; typhoid prophylactic, 5.6 cents per cubic centimeter; and typhoid and paratyphoid vaccines, 5.6 cents per cubic centimeter. The cost of making one Wassermann test is 21.5 cents. These prices are approximate, and include all overhead expenses.

The amount of anti-pneumococcus serum has been very materially increased. We continue to make both Type I and Type II, as each of these has a specific curative value. Clinical results received from some of the hospitals on the efficacy of anti-pneumococcus serum were incomplete, and because of this lack of information special efforts were made to establish the value of the Type II serum. Dr. R. Kohn, at that time assistant director, therefore concentrated his attention on the Type II serum treatment for pneumonia. He personally supervised the treatment of 25 cases in various hospitals, with 2 deaths, — a mortality of 8 per cent. The number of cases are too few to draw definite conclusions, but the results are encouraging. Laboratory tests show that our Type II serum has a high protective value against the Type II infection in mice, and its therapeutic use in man seems to be of value. The doses of Type II anti-pneumococcus serum have been about the same as those for Type I serum, namely, a large initial dose of 200 cubic centimeters or more, followed by smaller amounts as required.

The Division has again co-operated with the Bureau of Animal Industry in making diagnostic tests for glanders, rabies and other infections of animals.

The Division has assisted both the army and navy in different ways; thus 3,406 naval aviators were tested by the Wassermann reaction. We also furnished to some of the army and navy establishments in Massachusetts quantities of diphtheria antitoxin, anti-meningitis serum, vaccine virus and other products to meet special needs.

Perhaps the most important special activity of the Wassermann Laboratory has been in connection with the standardization of the Wassermann technique. Representatives from eleven of the largest laboratories in the State were called together by the Commissioner of Health. The technique used at the Wassermann Laboratory was adopted as a standard method of procedure for all laboratories performing this test throughout the Commonwealth. The Wassermann Laboratory has also been able to aid in the State venereal program in various ways.

The work of the Division has been increased, the number of its products multiplied, and the quality of its service improved.

Division of Hygiene.

Merrill E. Champion, M.D., *Director*.

Report of Division of Hygiene.

Changes in Personnel.

There have been no additions to the personnel of this Division during the past year. There have been, however, several changes. In May Miss Irene K. Griffin, who had served as a health instructor since February, 1917, resigned to be married.

June 1 Dr. Lyman Asa Jones was succeeded by Dr. Merrill E. Champion as director of the Division.

September 1 Miss Blanche Wildes, who had been loaned to the Child Conservation Committee, returned to regular duty with the Division.

In October Mrs. Ermyn Schell, who had served with us as clerk since February, 1918, resigned.

Child Conservation Work.

For various reasons, referable chiefly to war conditions and to lack of money for salaries, there have been no radical departures from the lines of work pursued or inaugurated last year.

The largest piece of work undertaken during the latter part of 1917, and carried on in at least one of its phases practically to completion in 1918, has been that represented by the activities of the child conservation committee. It will be recalled that this committee was appointed by Dr. Allan J. McLaughlin while Commissioner of Health, and was composed of Department members and child welfare experts from outside the Department. The first job undertaken by this committee was to survey the State with a view to determining the available resources in each city and town for the conservation of the health of the child. This survey, made by eight nurses, — one for each health district, — has been largely completed, 92 per cent of the population of the State having been reached. The year's report in full has been published in our monthly bulletin, "The Commonhealth," in a special child conservation number, dated September–October, 1918.

The results obtained cannot, of course, be credited to any one body of workers. The impetus to a large extent came from both Federal and State agencies, and was passed on to the local agencies in the dif-

ferent cities and towns. The seed carefully and patiently sown in the past by health officers, nurses and private workers was forced into an earlier and more abundant growth under the stimulus of the "children's year." The State Department of Health, especially through its Child Conservation Committee, may rightfully claim its due share in these results, and does not wish to claim more.

In addition to the work carried on in direct co-operation with the child conservation committee, the Division of Hygiene has continued various lines of work started previously to the present year. The policy has been continued of holding "health weeks" in various parts of the State. Our exhibit has been used at such times, in charge of one or two nurses who have given talks on health subjects, and demonstrations, more particularly for mothers and older girls, on the best method of washing, dressing and caring for the baby. Such health days or weeks were conducted during the year in —

Brookfield.
Fisherville.
Grafton.
Harwich.
Hudson.
Hyannis.
Lynn.
Marion.
Marlborough.
Millbury.
Monson.
North Brookfield.
Orleans.
Palmer.
Thorndike.
Three Rivers.
Provincetown.
Upton.
Ware.
Wareham.
Warren.
West Warren.
Yarmouth.

Similar exhibits, lectures and demonstrations were provided also at the agricultural fairs in the following towns: Marshfield, Barnstable, Weymouth and Sturbridge.

Lecture Service.

The lecture service of the Department has been continued. Various members of the Department have participated in this, though the child conservation nurses have done the major part of it. Owing to the tremendous absorption of the public in problems of food and fuel during the war, lectures on health had to take second place, in spite of the greatly increased need for the dissemination of health information. Moreover, during the summer a great deal of emphasis was laid by the Department on venereal disease propaganda. Furthermore, during the

influenza epidemic public meetings were undesirable, and acute disease, only, occupied, of necessity, the center of the stage. Since the two plagues, war and influenza, have ceased, a greater demand is shown for discussions of general public health matters. The following tables will give an idea of the lecture service for the year 1917–18.

Lectures were given during the year on the following subjects: —

Child hygiene,	384
Venereal diseases,	108
Foods and food inspection,	45
Public health,	21
Public health nursing,	18
Rural sanitation,	1
School hygiene,	7
Communicable diseases,	4
Wear and tear diseases of adult life,	2
Influenza,	4
Oral hygiene,	1
Quackery and patent medicines,	1
Tuberculosis,	1
	597

The above lectures were given by months, as follows: —

Month.	Lectures.	Number Present.
1917.		
December,	37	3,550
1918.		
January,	37	3,306
February,	107	13,397
March,	62	6,969
April,	87	12,142
May,	101	8,838
June,	47	6,420
July,	26	3,113
August,	41	21,843
September,	16	7,837
October,	4	1,410
November,	32	11,996
Total,	597	100,821

During the fiscal year ending Nov. 30, 1918, lectures were given in the following cities and towns: —

Adams,	2	Fall River,	8
Agawam,	1	Falmouth,	1
Amherst,	2	Fitchburg,	9
Andover,	1	Framingham,	1
Arlington,	2	Franklin,	2
Ashburnham,	2	Gardner,	3
Ashfield,	3	Georgetown,	1
Ashland,	1	Gloucester,	3
Athol,	15	Goshen,	1
Attleboro,	1	Grafton,	14
Auburn,	2	Great Barrington,	2
Ayer,	1	Greenfield,	5
Barnstable,	19	Harvard,	1
Barre,	3	Harwich,	10
Bedford,	1	Hatfield,	1
Belmont,	2	Haverhill,	3
Bernardston,	1	Hingham,	3
Beverly,	2	Holden,	1
Blackstone,	1	Holliston,	1
Boston,	66	Holyoke,	5
Bourne,	8	Hopkinton,	1
Boxford,	1	Hudson,	5
Brewster,	2	Hull,	1
Brockton,	4	Lancaster,	1
Brookfield,	3	Lanesborough,	1
Brookline,	4	Lawrence,	3
Buckland,	1	Lee,	4
Cambridge,	25	Leicester,	1
Chatham,	6	Lenox,	1
Chelsea,	3	Leominster,	4
Chicopee,	2	Lexington,	2
Clinton,	4	Lowell,	11
Cohasset,	1	Lynn,	10
Cummington,	3	Malden,	4
Dalton,	3	Manchester,	1
Danvers,	1	Mansfield,	2
Dartmouth,	12	Marblehead,	1
Deerfield,	2	Marion,	7
Dennis,	6	Marlborough,	5
Dighton,	1	Marshfield,	2
Eastham,	1	Mashpee,	1
Easthampton,	1	Mattapoisett,	7
Easton,	1	Medford,	1
Everett,	1	Medway,	2

Melrose,	1
Mendon,	1
Methuen,	1
Middleborough,	2
Milford,	3
Millbury,	6
Millis,	1
Millville,	1
Milton,	2
Monson,	4
Natick,	1
Needham,	2
New Bedford,	4
Newburyport,	1
Newton,	2
North Adams,	5
North Brookfield,	7
Northampton,	2
Northbridge,	1
Norwell,	1
Orange,	1
Orleans,	4
Oxford,	1
Palmer,	11
Peabody,	4
Pepperell,	2
Petersham,	1
Pittsfield,	10
Plainfield,	3
Provincetown,	3
Quincy,	9
Randolph,	1
Reading,	4
Revere,	2
Rockland,	4
Salem,	2
Salisbury,	1
Sandwich,	9
Saugus,	1
Shelburne,	1
Sherborn,	3
Shirley,	2
Shrewsbury,	1
Somerville,	1
Southampton,	1
Southborough,	1
Southbridge,	1
Springfield,	6
Stockbridge,	1
Stoneham,	2
Stoughton,	1
Sunderland,	2
Sutton,	1
Taunton,	3
Templeton,	1
Truro,	4
Upton,	4
Uxbridge,	1
Wakefield,	3
Waltham,	2
Ware,	3
Wareham,	6
Warren,	5
Watertown,	3
Webster,	3
Wellesley,	3
Wellfleet,	2
West Brookfield,	2
Westborough,	1
Westminster,	1
Weymouth,	1
Wilmington,	1
Winchendon,	1
Winchester,	2
Winthrop,	2
Worcester,	9
Yarmouth,	8
Total,	593

Concord, N. H.,	1
Manchester, N. H.,	1
Nashua, N H.,	1
New York City,	1
Total,	4

Stereopticon Slides and Moving Pictures.

Various additions have been made from time to time to our series of stereopticon slides. An automatic stereopticon lantern, the stereomotorgraph, was experimented with; this has not proved entirely satisfactory so far. An attempt is being made to secure a good portable moving-picture machine which can be used in any hall without conflicting with the fire prevention laws of the State.

Educational Material.

Various educational leaflets were published during the year. A series of articles on food, written by Mrs. Alzira W. Sandwall, for the monthly bulletin, was distributed as pamphlets. A set of "Food Rules for School Children" was prepared; these have met with a ready response. An excellent booklet on "The Care of the Child in Hot Weather," written for the Department by Dr. Richard M. Smith, was found most useful.

The most ambitious piece of work for the year, however, was the "Outline for a Course in Child Welfare," prepared for the use of vocational schools in particular, though suitable for use in any school. The State Board of Education co-operated with the State Department of Health in this matter, as did the Woman's Section of the Council of National Defense. I believe that this will be the beginning of a great advance in child conservation, for by this means a large body of women and girls will be taught the scientific basis of child welfare.

Monthly Bulletin.

Beginning with the July number the monthly bulletin was issued in revised form under the title of "The Commonhealth." A double number, dealing with child conservation and containing a report of last year's work, was published in October.

Publicity.

During part of the year, through the courtesy of the Massachusetts Health Committee, we have had the benefit of the assistance of an expert publicity engineer, Prof. Charles E. Bellatty of Boston University. He has aided us in getting our message across to the public.

Infantile Paralysis After-care.

The Infantile Paralysis Commission of Harvard University has continued its co-operation with us during the past year, entirely without financial obligation on our part.

Food in its Relationship to Health.

One phase of the work of this Division which represents an incursion into a somewhat new field is that of food in its relationship to health. This branch has been in charge of Mrs. Alzira Wentworth Sandwall, who has made of it a definite entity. Original stereopticon slides and poster exhibits have been prepared and found most useful. Helpful relationships have been formed with agencies doing similar work.

During the summer, through the courtesy of Miss Agnes Donham of the Garland School for Homemaking, this Division was privileged to maintain a health exhibit on the food trolley which traversed the eastern part of the State.

Contact with New Agencies.

It has been the constant aim of the director to reach new agencies which can aid in furthering the health work of the State. The new contact through the vocational schools has already been referred to. We are now working in close co-operation with the home demonstration agents in charge of the agriculture and home economics activities of the State. Especial mention should be made of the valuable assistance of the various local child conservation committees of the Women's Section of the Council of National Defense. Still closer relationship will be sought with all these agencies and with the granges and parent-teacher associations.

Investigations in Other Communities.

During the current year a visit was made by the present director of the Division to Toronto to study the nursing system there, and more especially to investigate the Toronto method of handling school hygiene.

New Lines of Activity suggested.

Extension of Cancer Work.

During the year 1917–18 the State Department of Health has had the benefit of the service furnished by the Cancer Commission of Harvard University. Pathological specimens sent in by hospitals and physicians have been examined free of charge by an expert pathologist. The service has cost the Commission about $4,000, but the expense to the State Department of Health has been only that of furnishing the containers for the specimens, at a cost of approximately $50. The value of this service has been twofold. First, expert service, ordinarily very expensive, has been furnished to physicians and hospitals free,

thus rendering an accurate diagnosis available to all. Second, the service has been of very great educational value in that it emphasized the vital need of early, accurate diagnosis and surgical treatment.

The coming year, the Department should assume the greater part of this expense.

Medical Social Service.

It has long been recognized that there are two classes of persons needing assistance. One of these classes is made up of paupers, properly so called, — persons who are chronically unable to handle, unaided, their own affairs. The other class, one which is infinitely more promising than the first, is composed of persons who, because of temporary ill health, or because of a certain degree of permanent physical impairment, are for the time being unable to control their environment. These persons, if neglected, tend to drift into the pauper class. If, on the other hand, they receive just the right lift at the right time, they may be returned to the class of those entirely self-supporting.

It is the duty of medical social service to rehabilitate the last-mentioned class of persons. Is it the duty of the State to oversee and co-ordinate such effort? As a result of the work done in following up those in difficulties because of the recent influenza epidemic, it is the firm conviction of many interested and experienced individuals that such a function does properly belong to the State in general, and to the State Department of Health in particular. It would seem a reasonable and sane step to take to request the Legislature for an appropriation to enable the Department of Health to study thoroughly this subject in all its aspects.

Day Nurseries.

As a result of the entry of women into industry a genuine problem in child conservation is presented by the growth of the day nursery. Many arguments may be addressed on both sides of the question as to the desirability of day nurseries. It would seem reasonable that every effort should be made, through the liberal use of mothers' aid pensions and other agencies, to keep the mother of small children at home. On the other hand, certain women are obliged to work or will work and, as a result, something must be done to care for their children. There is a strong movement on foot to ask for legislation looking to the regulation of day nurseries in order to safeguard the children cared for in them. It is the belief of many that such regulation should be in the hands of the State Department of Health.

School Hygiene.

One of the most pressing problems brought to the front as a result of the war has been the prevention and correction of physical defects in children. Various estimates have been made, but conservative figures for the draft would lead us to believe that 25 per cent of the rejections were due to defects which might have been prevented or remedied during the early years of life.

Massachusetts has had for eleven years a school inspection law under the provisions of which every city and town in the Commonwealth must have one or more school physicians. It is easily seen, however, from the investigation made two years ago by this Department, that there is no co-ordination in medical school inspection in this State, and furthermore, that much of it is nominal only. A weak point in the law is the absence of any provision making compulsory the employment of school nurses.

The remedy for this state of affairs would seem to be a co-ordination and standardization of effort through the enforcement of rules and regulations made by a central body like the State Board of Education or the State Department of Health. It makes little difference which of these two departments is actually in direct charge of the work; both are equally concerned, and regulations should be drawn up only after careful consideration on the part of the two departments.

A further important factor in the school hygiene problem is the teaching of hygiene. Modern scientific instruction in this most indispensable subject under competent teachers should be required in all schools, including the normal schools. Some effort should be made this year looking toward adequate legislation on the subject of school hygiene.

Report of the Board of State Examiners of Plumbers.

James C. Coffey, *Chairman.*

Report of the State Examiners of Plumbers.

Information concerning Examinations for Plumbers, showing the Place and Date of Examination and Number examined, together with the Results of the Examination, etc.

Examinations.	Examined.	Passed.	Refused.
Boston, Dec. 1, 1917,	57	17	40
Lowell, Dec. 15, 1917,	17	3	14
Boston, Jan. 5, 1918,	42	14	28
Pittsfield, Jan. 19, 1918,	11	5	6
Boston, Feb. 2, 1918,	44	14	30
Springfield, Feb. 16, 1918,	22	8	14
Boston, March 2, 1918,	65	19	46
Fall River, March 16, 1918,	21	5	16
Boston, April 6, 1918,	71	19	52
Worcester, April 20, 1918,	29	4	25
Boston, May 4, 1918,	42	8	34
Lowell, May 18, 1918,	17	5	12
Boston, June 1, 1918,	57	16	41
Pittsfield, June 15, 1918,	5	1	4
Boston, July 6, 1918,	59	19	40
Boston, Sept. 7, 1918,	44	9	35
Springfield, Sept. 21, 1918,	13	4	9
Fall River, Oct. 26, 1918,	9	2	7
Boston, Nov. 2, 1918,	45	13	32
Worcester, Nov. 16, 1918,	10	1	9
Totals,	780	186	494

	Masters.	Journeymen.	Total.
Licenses granted on account of examination Dec. 1, 1917, to Dec. 1, 1918.	54	130	184
Probationary licenses issued during the year,	–	7	–

Registrations.	Masters.	Journeymen.
December, 1917,	3	17
January, 1918,	7	13
February, 1918,	5	13
March, 1918,	8	19
April, 1918,	1	8
May, 1918,	5	17
June, 1918,	9	19
July, 1918,	5	17
August, 1918,	5	1
September, 1918,	3	8
October, 1918,	4	9
November, 1918,	6	9
Totals,	61	150

Meetings,	63	Examinations,	20

Fees received.	Paid to the Treasurer of the Commonwealth.
680 examination fees, at $0.50,	$340 00
61 master plumber licenses issued, at $2,	122 00
148 journeyman plumber licenses issued, at $0.50,	74 00
1,692 master plumber renewals issued, at $0.50,	846 00
3,912 journeyman plumber renewals issued, at $0.50,	1,956 00
123 back fees, at $0.50,	61 50
Total,	$3,399 50

For carrying out the Provisions of the Act relative to the Examination of Plumbers.

Salary of secretary,	$2,000 00
Examiner's wages,	565 00
Traveling,	551 00
Express,	29 14
Printing,	158 32
Postage,	195 02
Books, stationery and supplies for typewriter,	18 31
Plumbers' materials,	4 00
Extra services,	940 00
Cleaning,	25 00
Office supplies,	1 00
Telephone and lighting,	91 44
Miscellaneous,	6 75
Total,	$4,585 84
Unexpended balance,	214 16
	$4,800 00

Summary of Registrations.

	Masters.	Journeymen.
Certificate holders,	469	490
Licenses, year ending May 1, 1918,	1,836	4,260
Totals,	2,305	4,750

Deceased Plumbers (reported to Examiners).

Masters, 6 | Journeymen, 5

Respectfully submitted,

JAMES C. COFFEY.
CHARLES R. FELTON.
DAVID CRAIG, *Clerk.*

INDEX.

INDEX.